REPORT OF THE COMMITTEE ON COAL MINE FIRES

GOVERNMENT OF INDIA
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FOREWORD

Coal mining areas have suffered considerable damage on account of underground fires which have been there with varying degrees of intensity for the last forty years. These fires pose a national problem, for they not only destroy valuable coal underground but also cause damage to life and property. They are caused by unscientific methods of working the mines and at times by acts of negligence. A well thought-out plan is necessary to prevent their occurrence and to stop further damage. The Committee of experts set up by the Planning Commission has done well to look closely into the causes of these fires in the past, to examine the methods and practices of controlling them and to suggest measures to prevent occurrence of mine fires. I hope the findings of this Committee will receive due consideration from the coal industry as well as from the authorities responsible for the safe working of mines.

Experts who served on this Committee deserve our thanks for their contributions to this study.

PITAMBAR PANT

Planning Commission
New Delhi
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CONTENTS

PAGE

I. INTRODUCTION 1

II. HISTORY OF THE MINE FIRES 6

III. STATUTORY PROVISION TO PREVENT OCCURRENCE OF MINE FIRES AND TO CONTROL THEM 19

IV. REVIEW OF THE PRESENT POSITION 27

V. NEED FOR RESEARCH 31

VI. RECOMMENDATIONS 33

VII. APPENDICES AND ANNEXURES 37

APPENDIX I Note of dissent, including additional recommendations by Dr. K. N. Sinha, Director Central Mining Research Station. 39

APPENDIX II Note of dissent by Shri A. K. Mitra, Chief Mining Engineer, Coal Board 46

ANNEXURE I Circulars issued by the Director-General of Mines Safety, (Formerly Chief Inspector of Mines) on the prevention and control of coal mines fires and methods of mine working 48

ANNEXURE II History of mine fires. 79

ANNEXURE III Extract from coal mines regulations 1957 regarding mine workings and precautions against dangers from fire 113

ANNEXURE IV Provisions relating to mine fires and methods of workings under coal mines (Conservation & Safety) Act and Rules. 124

I. INTRODUCTION

Background

Some of the fires now burning in the coalfields started in the twenties or thirties though some of them are of later origin. A number of fires were extensive in area and intensive in magnitude and it was therefore difficult to control them, chiefly because they were at shallow cover. Flooding of the fire areas was not practicable in these cases as inundation of the workings upto the level of the fire involved raising of water level upto a point which was either not possible to achieve or would have resulted in flooding of neighbouring collieries or other parts of the same mine.

2. Most of the fires in coal mines have originated from spontaneous combustion occurring either underground or on the surface. There are a number of mines in which pillars formed were robbed or reduced in size before the introduction of the Coal Mines Regulations, 1937, which for the first time prescribed the size of pillars and galleries for stability of workings. Premature collapses and fires were therefore not uncommon in the workings formed before 1937. The possibility of premature collapses in the workings formed after 1937 has, however, reduced considerably. But there is another factor leading to spontaneous heating, and that is the tendency of certain coals to undergo spheroidal weathering. As a result of this weathering, the old pillars undergo spalling and this is sometimes followed by spontaneous heatings and fire in the fallen coal lying in the workings. Underground fires have also occurred in the goaves as a result of coal having been left behind after depillaring operations, as it is not possible to extract all the coal in the pillars. A number of fires have occurred due to these causes, but they were promptly sealed off and brought under control by building stoppings underground all around the fire area. In some cases where such isolation could not be effective in shallow workings due to circulation of air through surface cracks which could not be effectively blanketed, some fires have remained uncontrolled. In some others more than one seam

went on fire due to damage to the intervening strata as a result of extraction by caving system. Some fires have occurred in quarry debris at the surface due to hot ashes being thrown negligently on the debris. 'Bontulsi' which grows widely in the coalfields has also been responsible for starting or spreading of fires in dry season. Illicit distillation in underground abandoned workings in some cases has been responsible for starting fires. There have also been a few cases of fires in coal pillars.

3. Mine fire is a national problem. A mine fire is not only dangerous to the workers employed in mines, but it also results in heavy loss of valuable coal, which is a national asset and is the primary source of energy for economic development. It has therefore been the constant endeavour of the mining industry and the Government authorities to take adequate measures against occurrence of mine fires, and to control a fire when it occurs so as to extinguish it or, when this cannot be done, to confine it to within as small an area as possible. Fires in coal mines have so far consumed millions of tonnes of coal. According to an estimate made by the Coal Board about 22 million tonnes of extractable coal has been lost in major fires.

4. It is, however, not possible to eliminate fires completely, as the very process of mining introduces factors which contribute to spontaneous heating of coal. A coal formation is a vast bed of combustible fuel. Air is freely available to the coal during mining operations. All that is required to initiate combustion is a source of heat to rise the temperature of fuel. If the coal is heated to about 93°C (200°F) and Oxygen in the air is available, the accelerated rate of oxidation at 93°C, assuming that the heat of oxidation accumulates more rapidly than it dissipates, is such that the chemical reaction will continue to the point of ignition, which is between 427°C (800°F) and 482°C (900°F). Such conditions often prevail because of the insulating effect of the strata surrounding the coal bed and when conditions are such that the heat from the accelerated oxidation is not dissipated by free circulation of air.

5. This, however, does not mean that we cannot do much to prevent the occurrence of fires and to tackle and

control them. In fact, considerable work has already been done in this direction. The Coal Mines Regulations, 1957 lay down in considerable detail the precautionary measures that should be taken to prevent occurrence of fires in mines and to control them. In addition to the statutory requirements, the Director-General of Mines Safety (formerly Chief Inspector of Mines) has been advising the industry, from time to time, through circular letters, about further precautions that should be taken in the light of experience gained by the officers of the Directorate and the latest researches in the field either at home or abroad. The relevant circulars are appened as Annexure I. In the event of occurrence of a mine fire, the Coal Board formed under the Coal Mines (Conservation & Safety) Act, 1952 undertakes practical measures, in consultation with the officers of the Directorate-General of Mines Safety, to fight the fire either by assisting and advising the affected colliery or by carrying out the work departmently so as to control the fire and to prevent its spreading to neighbouring mines or areas. The Central Mining Research Station has taken up a number of research projects dealing with various problems associated with mine fires in India. A large volume of information is reported to have been collected.

Formation Of The Committee

6. Since these fires were not only leading to waste of coal, but also causing serious hazard to safety, and subsidence was adding to these safety hazards, apart from causing damage to sturcture of national importance, the Technical Committee on Minerals of the Planning Commission decided in May 1963, that problems of coal mine fires, subsidence and other allied problems relating to mine working needed a detailed study. A Committee comprising representatives of the Coal Board, Central Mining Research Station, Indian School of Mines, Indian Bureau of Mines, Directorate-General of Mines Safety and the Planning Commission was set up to undertake the study. In a meeting held on the 22nd October, 1964 it was decided that the study on coal mine fires, subsidences and problems relating to mine working should be divided in two parts, viz:

(i) Mine subsidences, and

(ii) Study of the interlinked subject of coal mine fires and the methods of mine working. The Committee completed its reports on November 9, 1967.

7. The present report deals only with coal mine fires and methods of mine working in that context.

8. The following was the composition of the Committee:

1	Shri A. B. Guha, Adviser (Resources) Planning Commission.	Chairman (Since inception up to August, 1966 when he retired).
2	Shri Chhedi Lal, Adviser (Resources) Planning Commission.	Chairman (Since August, 1966 up to the completion of the report).
3	Shri A. C. Bose, Chairman, Coal Board. .	Member
4	Shri S. N. Sahgal, Coal Mining Adviser. .	Member
5	Shri G. S. Jabbi, Director General of Mines Safety	Member
6	Dr. A. K. Dey, Senior Specialist (MR) Planning Commission.	Member
7	Shri S. C. Dey, Director of Planning, National Coal Development Corpn. Ltd. .	Member
8	Prof. D. N. Prasad, Director, Indian School of Mines, Dhanbad.	Member
9	Dr. A. B. Dutt, Consulting Geologist, 10, Cornfield Road, Calcutta.	Member
10	Dr. K. N. Sinha, Director, Central Mining Research Station.	Member
11	Shri A. C. Bose, Chief Engineer, Indian Bureau of Mines, Nagpur.	Member
12	Shri B. K. Ghosh, Chief Mining Engineer, Coal Board (Until 1968).	Convenor

9. Since the setting up of the Committee, Sarvashree S. N. Sahagal, A. C. Bose (I. B. M.) and B. K. Ghosh have retired. In their place Sarvashree K. S. R. Chari (Ministry of

Mines & Metals), P. K. Ghosh (G. S. I.) and A. K. Mitra (Coal Board) respectively were appointed to the Committee. Dr. A. K. Dey has since retired and Shri S. C. Dey expired in April, 1967.

Terms of Reference

10. The Committee was given the following terms of reference:

(1) To review the past coal mine fires and the prevalent methods and practices of controlling them,

(2) To recommend the best methods of fighting and controlling fires.

The recommendations cover a wide field and include such aspects as additional powers to be vested with the Coal Board and the need for continuous research for prevention, detection and control of mine fires. Dr. K. N. Sinha and Shri A. K. Mitra have, however, not agreed with certain portions of the report. They feel that there is no need to set up the proposed Mines Development Board, as it will be conflicting with the functions of the Coal Board. The Coal Board should be the single authority to take complete charge of mine fire, and to enable it to discharge its functions effectively, the financial rules should be adequately relaxed. Shri Sinha is of the view that though the Coal Board should be statutorily empowered to require all collieries to submit their development and other working plans, a single authority or committee should be set up to which all collieries will submit their plans for development and extraction which should be detailed and time targeed. These plans should be drawn in broad outlines ten years in advance, in details three years in advance and submitted for approval about two years in advance of starting the operation. These divergent views will need further consideration by the appropriate authorities.

11. The Report incorporates information made available mainly by the Coal Board and the office of the Director General, Mines Safety. The committee expresses its gratefulness to Sarvashree S. C. Gupta of the Coal Board and Ahuja of the office of the Director General of Mines Safety for the assistance rendered by them.

II. HISTORY OF THE MINE FIRES

1. A history of mine fires that has been compiled by the Coal Board is given in the statement (Annexure II). The statement lists each known fire mine-wise, year in which it orginated, coal seams affected, cause of fire, measures adopted to control the fire and its present position.

2. As would be noted, Annexure II gives the history of 158 mine fires. The incidence of these fires cause-wise and coalfield-wise is given in Table I on the facing page. Broadly speaking, the cause of the fires may be classified in two categories, namely :

(1) Fires caused by spontaneous heating.

(2) Accidental Fires.

3. A breakdown of fires under these two main categories is given below :

(1) *Fires caused by spontaneous heating*

(i) Premature collapse/crushing followed by spontaneous heating (18)*

(ii) Spontaneous heating underground (46)

(iii) Spontaneous heating surface (4)

(iv) Spontaneous heating in quarry overburden (44)

(v) Spontaneous combustion in washery rejects (1)

Total 113

(2) *Accidental Fires*

(i) 'Bontulsi' (Osimum basilicum) conflagration (5)

(ii) Illicit Distillation either in abandoned quarries or in underground workings (5)

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*Figures in brackets given number of fires.

(iii) Negligent Acts e.g. dumping of hot ashes, soft coke making etc. at quarry edges or along outcrops of coal or over surface subsidences (21)

(iv) Other causes—(14)

  (a) Fire crossing from neighbour mine/areas

  (b) Breakdown of insulation of electric cable

  (c) Belt fire

  (d) Brattice cloth catching fire due to shot-firing

  (e) Explosion.

Total 45

4. Table II shows the protective measures that were adopted to control the mine fires, and the number of cases in which the measure(s) adopted brought the fire under complete control. As would be seen this success was achieved in 108 cases. In 47 cases the fire has been more or less brought under control but work is still in progress. In 3 cases, the fire was allowed to burn itself as it did not threaten any other area and the control work was considered to be uneconomical.

Control Methods

5. As it would be appreciated, each fire presents its own unique condition so that a control method suited to each fire must be selected depending on the extent of the fire along the outcrop and underground as well as how long the fire has been burning. In most of the cases, a fire was tackled by a combination of different known methods of control. Singly, the methods that have been used may be classified as follows:

(1) *Digging* and loading out.

(2) *Trenching.*

(3) *Surface Sealing,* that is sealing of openings to the surface, filling up of subsidence cracks, and/or surface blanketing with sand and/or earth or with waterpooling in terraces, or by filling the cracks and levelling the surface with dozers.

(4) *Underground sealing* by isolation stoppings.

(5) *Underground Incombustible Barrier:* Creation of incombustible barrier underground by packing, hydraulic sand stowing or sand or 'mutti' flushing through boreholes put down from the surface into the fire area.

(6) *Flooding* of workings.

Scope and Application of Different Control Methods

6. For proper appreciation of the limitations of the different control methods, the scope and application of each such method is given below:

(1) *Digging and Loading Out*

A fire may be dug and loaded out when a relatively small amount of material is affected and it is under shallow depth. Water should be available for cooling the hot material during excavation. Conditions generally favourable to loading out prevail when the fire is of recent origin.

(2) *Trenching*

A trench barrier is intended to confine and isolate the fire from the main body of coal. The barrier must break the continuity of all coal and carbonaceous shales and also be wide enough to prevent the transfer of heat from the fire area to the opposite side. Unless the barrier is wide enough to prevent heat transfer, active combustion can be initiated in the carbonaceous material on the protected side of the barrier even though the continuity of the bed has been broken. After the burning coal is isolated, the fire will be extinguished for lack of fuel when the combustible material in the isolated area has been consumed.

A trench barrier is provided by excavating an open trench between the fire area and the threatened area, and either keeping it open or back filling it with incombustible material. The trench extends vertically from the surface to the floor of the seam and horizontally from the outcrop on one side of the fire to the outcrop on the other side.

TABLE I

Incidence of Mine Fires Causewise and Coalfieldwise

sl. no.	cause	coalfield							Total
		Jharia-Mugma-Katras	Raniganj	Ramgarh Karanpura-Bokaro	Singareni	Madhya Pradesh	Talcher	Assam	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	premature collapse/crushing followed by spontaneous heating	10	8	..	..	..	..	..	18
2	(a) spontaneous heating (u/g) .	15	18	1	3	7	1	1	46
	(b) spontaneous heating (suface).	4	..	..	..	..	..	..	4
3	'Bontulsi' conflagration . .	5	..	..	..	..	..		5
4	illicit distillation . . .	5	..	..	..	..	..	..	5
5	spontaneous heating in quarry overburden containing carbonaceous matter (dumped) .	31	3	7	..	3	..	..	44

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
6	negligent acts e.g. dumping of hot ashes, soft coke making etc.	20	..	1	..	..	..	..	21
7	spontaneous combustion in washery rejects . .	..	..	1	..	..	..	..	1
8	other causes—								
	(a) fire crossing from neighbouring mine/area . .	6	3	1	..	..	..	..	10
	(b) miscellaneous . . .	..	3	..	..	..	1	..	4
	totals	96	35	11	3	10	2	1	158

TABLE II

Measures adopted to Control Mine Fires

Sl. No.	control method	number of cases in which the protective measures were		fire allowed to burn itself
		successful (fire completely under control)	partially successful (work continuing)	
(1)	(2)	(3)	(4)	(5)
1	surface blanketing with sand and earth	6	2	
2	surface blanketing with sand and underground sealing with dams	..	2	
3	sealing of openings, and partial inundation underground .	..	2	
4	surface sealing, and underground stoppings . .	3	..	
5	flushing with sand underground, trenching and surface blanketing . . .	1	1	
6	inundation	4	4	
7	trenching and loading out of heated debris . . .	10	2	
8	partial inundation . . .	..	2	
9	partial inundation, sand flushing through boreholes, trenching and sand blanketing .	4	..	

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(1)	(2)	(3)	(4)	(5)
10	partial inundation and surface blanketing	1	13	
11	trenching, partial inundation and surface blanketing	..	2	
12	underground isolation, surface trenching and blanketing underground packing and flushing with sand through boreholes	1	1	
13	surface blanketing with water pooling	..	1	
14	underground stoppings and sand barrier surface blanketing and sealing	2	1	
15	underground sand packing and surface blanketing	..	1	
16	underground stoppings and sand barrier	2	1	
17	trenching, backfilling, terraced fields, underground stoppings and dams	..	1	
18	digging out, and creation of water barrier, underground inundation	1	..	
19	digging out	13	4	
20	trench cutting and partial inundation	..	3	
21	trench cutting, digging out and blanketing	3	..	
22	trenching	14	2	
23	surface ploughing with bull dozer	1	..	

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(1)	(2)	(3)	(4)	(5)
24	surface blanketing and sealing of cracks etc., flushing of 'mutti' and sand through boreholes	8	..	
25	trenching and filling with water	1	..	
26	digging out and underground isolation stoppings . .	..	1	
27	trench cutting, sufrace sealing sand-blanketing, underground stoppings	..	2	
28	surface blanketing with earth and underground sand barrier.	..	1	
29	surface blanketing and sealing of openings . . .	1	1	
30	inundation and sealing . .	8	1	
31	underground sealing . .	15	..	
32	underground sealing and surface blanketing . . .	3	3	
33	sealing of pits/mine entrances .	4	..	
34	water and cement/chemicals injection in pillars underground	2	..	
35	surface sealing and blanketing	..	1	
36	sealing by stoppings and dams, surface blanketing, concrete and flushing in fire area from surface boreholes	..	..	
37	isolation stoppings, packing of galleries and surface blanketing	..	1	
38	*no action*	..	..	3
	totals	108	47	3—158

The minimum width of the trench should be 4.5 metres (15 ft.) at the bottom. The depth of the trench is a limiting factor. It is generally difficult to attempt a trenching operation where the cover is much greater than 15 metres (50 ft.).

The site of the trench should be suitably selected to ensure its completion before the advancing fire reaches the site. It should be cut with all speed so that the fire cannot cross the point before its completion. Although ordinarily an open trench will serve the purpose of cutting off the fire and preventing the transfer of heat to contiguous coal, it may become necessary in some cases to back fill the trench particularly when there is danger of the sides of the trench collapsing and filling the trench with combustible materials. Sometimes trench is also filled with water to act as a barrier.

A trench barrier has several drawbacks in application. It is primarily a means of preventing the spread of fire and is not intended to extinguish the fire within the isolated area. In the isolated area, the fire continues to burn so the fire hazards and damages are not eliminated in the isolated area. In addition, its provision is relatively an expensive operation. It usually involves the excavation of large quantities of material, the carbonaceous portions of which require disposal or special treatment; and if it becomes necessary to back fill it the cost will shoot up. Another serious drawback of the method is that the fire may advance beyond the proposed trench line, as has actually happened in a number of cases in India and other countries. This possibility arises because of the difficulty of delineating the course and progress of the fire before excavating operations are begun since an extension of fire may travel through an entry of the mine far in advance of any superficial evidence, and this advance may not be detected even by exploratory drilling.

(3) *Surface Sealing*

Surface sealing is a method of controlling and extinguishing an underground mine fire by closing surface cracks and openings leading to the fire. The method is generally applicable to those fires which are under shallow cover near outcrop of the coal seam. To be successful, in addition to initial sealing of the fire, the seal must be maintained until the heat of the fire has been conducted through the surrounding rock strata to the surface and dissipated in the atmosphere. The surface sealing method therefore consists of two phases: (a) A sealing phase during which a thick layer of sand and/or pulverised earth is placed on the surface over the fire area, and (b) a maintenance phase during which the surface layer is maintained in an effective condition until the temperature of the affected area is reduced sufficiently to prevent re-ignition (as verified by inspection bore-holes, say 15 cm (6″) dia, specially put down in the fire area for the purpose of taking temperature readings. All readings should be obtained from the same elevation in a particular bore-hole. The temperature readings can be obtained by using a thermocouple, extension wires, and potentiometer. A temperature probe may be used for taking readings at shallow depths in soft ground or debris).

Two methods of establishing a surface seal can be used. One method creates a seal by ploughing the surface in stages to a pulverised condition using an angle dozer, the resulting layer of pulverised earth being from 1.0 to 2.5 metres deep. The second method, which has been used extensively in India is the blanketing of surface by transporting sand and/or clay to the surface over the fire area and spreading it in such a way as to maintain a uniform thickness. Sand alone does not form a good blanket, as it permits circulation of air. It is necessary that the top layer should be that of clay varying in thickness from 0.5 to 1.5 metres. When clay is used to blanket the surface, it is kept moist to be effective, as otherwise it will dry up and crack. The method commonly used in such a case is to retain water in terraces that are made for the purpose over the affected area.

The surface sealing method is very often the only economically feasible method of attempting to control a fire extending through a large area. The operation can be best performed by earth moving machinery. Effective surface sealing cannot, however, be accomplished where surface water or sewage is permitted to enter the underground workings of a mine on fire. These openings even when equippea with traps, permit oxygen to reach the fire by aeration and induced flow.

(4) *Underground Sealing*

This is the chief method of controlling a fire in a working mine where the fire has occurred due to spontaneous heating in a goaf or old working containing huge quantities of fallen coal. The method consists of building fire stoppings of approved design and specifications in all entries reaching to the fire area with a view to cut off all air going to the fire.

(5) *Underground Incombustible Barrier*

This may be provided either by underground packing of galleries or by flushing.

(i) *Packing:* In this case the galleries around the fire area are packed with incombustible materials. The barrier should be at least 4.5 m (15 ft.) in thickness and extend from the floor of the coal seam to a height above the carbonaceous shales, if present above the coal bed. The galleries should be tightly filled with incombustible materials, or stowed hydraulically with sand.

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(ii) *Flushing:* It is a method designed to fill the voids in an underground fire area with sand or other finely divided incombustible solids. The objective is to prevent flow of air to the burning coal and carbonaceous shale by filling crevices, voids etc., and to some extent opening in the overlying strata. It is an effective method of filling entries or mine cavities if they can be located by drilling. It is also an effective method of stabilising the underlying starta Small fires in flat beds with a simple mine layout can be controlled by this method but the method may fail when attempting to extinguish an extensive fire in an abandoned mine. It is difficult to confine the material to the fire area in steeply inclined workings especially when a number of continuous seams or sections are involved. The method is, however, more sucessful when simultaneous work can be done underground to direct and confine the incombustible solids from the slurry.

(6) *Flooding of Workings*

Flooding the fire area in our country has been done only with water, although in some countries other media such as steam, inert gas, or chemicals have been tried.

The inclination of the coal bed, the location of underground coal barriers and position of adjacent mines, the number and kind of surface openings, and the presence of large fissures and fault planes affect the case with which water can be confined. Conditions that favour flooding are: (a) a fire area below the normal surface water—drainage level, (b) a sufficient quantity of water available to flood the mine areas, and (c) the affected mine isolated or capable of being isolated from the neighbouring mine so that it is not threatened with inundation. Under these conditions, the water flooding method holds out much promise of success.

Inert gases and vapours e.g. CO_2 and steam have been tried in some other countries as media for flooding underground fires. Carbondioxide is a good fire-extinguishing agent, but has practically no cooling effect, and for this reason it is usually recommended for flash fires where there is much flame but relatively little stored-up heat. It accomplishes its objective in these instances by momentarily excluding oxygen from the fire. When used on a mine fire, this gas is usually difficult to confine to the fire area long enough to permit the cooling of hot materials. It is difficult and laborious to introduce in effective quantities, and if a large quantity of CO_2 is required it might be prohibitively expensive.

Water vapour in the form of steam has essentially the same effect as carbondioxide gas in that it will exclude oxygen and extinguish the fire. It has the added advantage of penetrating voids and crevices to higher elevations where the oxidation of combustible is generally more rapid and intense. By applying water to a fire and converting it to steam much heat is absorbed (roughly 13,400 gm. calories or 1000 B.T.U.

per pound of water). Water when applied to very hot materials (at over 870°C) may, however, combine with carbon to form carbonmonoxide and hydrogen. Under some conditions this would present a health and explosion hazard. But because it is possible to dissipate great quantities of heat with a minimum of water when it is changed to steam, research work may be done to define the scope of application of this method.

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III. STATUTORY PROVISION TO PREVENT OCCURRENCE OF MINE FIRES AND TO CONTROL THEM

Mines Act, 1952

1. The Coal Mines Regulations, 1957 framed under the Mines Act, 1952 lay down precautions that should be taken to prevent the occurrence of fires in mines, and to control the fire should it occur in a mine. Besides these statutory provisions, the Director-General of Mines Safety issues circulars from time to time advising the mine managements about further precautions that may be taken in this regard. Some of these circulars are in amplification of the regulations and others recommend additional precautions in the light of experience gained in dealing with mine fires and researches made in the country and abroad in preventing and controlling the fires.

2. The precautions laid down under the Coal Mines Regulations, 1957, and those recommended in the circulars are reproduced at Annexure III. They are summarised below under the two broad classifications of causes of mine fires, namely, (1) Fires caused by spontaneous heating; (2) Accidental Fires :

(i) *Precautions for prevention of occurrence of mine fires*

(1) The dimensions of pillars and gallaries formed in any seam should be adequate to ensure stability during the formation and extraction of pillars and during the period between such formation and extraction. This is with a view to prevent premature collapses and resultant occurrences of fires (Regulation 99).

(2) Plans showing proposed methods of development and depillaring should be submitted for approval at least three years in advance (Circular No. 16 of 1964). The layout of bord and pillar workings should be done on scientific lines as mentioned in Circular No.

7 of 1966. (The favoured method is to open out a seam or part of a seam by driving 4 or 5 headings along strike and then along dip and rise upto the mine boundary or a pre-determined barrier as quickly as possible, and to form panels on the retreat. In this method of working, a system of more or less simultaneous development and depillaring could be conveniently arranged in the same panel or adjacent panels with many obvious advantages against dangers of fire and crush of pillars etc.).

(3) The extraction or reduction of pillars should be conducted in such a way as to prevent the extension of a collapse or extension of goaf over pillars which have not been extracted (Regulation 100 (2)).

(4) Where extraction is done by caving system, the operations should be conducted in such a way as to leave as small an area of uncollapsed roof as possible (Reg. 100(5)).

(5) Before extraction of pillars with caving system or with stowing, isolation/preparatory stoppings should be provided to seal off the area. Doors or Emergency Door Seals should be provided in preparatory stoppings (Regulation 100(4) read with Circular Nos. 7 of 1960; 41 of 1962; 55 of 1962; 37 of 1963; 25 of 1964; 2 of 1965; 19 of 1967).

(6) All goaves or crushed areas should be kept sealed (Circular No. 7 of 1960; 23 of 1960; 23 of 1965).

(7) Proper provision should be made to prevent premature collapse of workings, and whenever any 'crush' takes place steps should be taken to remove loose coal or to isolate the area as the case may be (Re. 102(2)).

(8) Broken coal should not be allowed to remain underground. All fallen coal should be removed promptly and completely. Where this is not possible, it should be sealed with flushing of sand etc. (Regulation 118

(4)(a) and Circular No. 7 of 1960 read with Circular No. 2 of 1967).

(9) All underground places should be properly ventilated. Provision should be made for dividing the workings into independent ventilation districts with due regard to fire risk. (Regulations 130 and 135 and Circular No. 7 of 1960).

(10) *Seams liable to spontaneous heating should be worked in conjunction with stowing.* Only non-inflammable material should be used for stowing the goaves. However, if it is not possible to stow the goaf, the coal seam should be divided into panels of a size compatible with the incubation period of the coal seam. *Records should be kept to ascertain incubation period of the seam.* (Circular No. 7 of 1960, Circular No. 9 of 1963, and conditions of permission for depillaring granted by the Director-General of Mines Safety in pursuance of Regulation 100 (1).)

(11) In those parts of the mine where there is chance of a fire breaking out, regular analysis of air samples should be carried out to determine the variation of CO/O_2 and CO_2/O_2 ratios. Effective steps by controlling the ventilation or by sealing off should be taken in case heating is suspected (Circular No. 7 of 1960).

(12) Depillaring districts should be inspected on rest days also for any symptoms of spontaneous heating. Once a day, tests should be made with approved type of carbonmonoxide detector (Circular Nos. 7 of 1960 and 2 of 1965).

(13) *Isolation stoppings should be provided around old workings* specially liable to spontaneous heating (Circular No. 66 of 1964).

(14) In coal seams that abound with natural prominent cleavage planes or geological disturbances, the intake and return airways should be, as far away as

possible to avoid possibility of outbreak of fire in solid coal pillars lying between intake and return (Circular No. 17 of 1965). Possibility of outbreak of fire in solid coal pillars lying between intake and return (Circular No. 17 of 1965).

(15) Following installation of a mechanical ventilator at a mine, old seals should be strengthened and a watch should be kept on the sealed off area by regular air sampling (Circular No. 17 of 1966).

(ii) *Measures for control of fires*

(1) Effective arrangements such as fire extinguishers, sand, water mains should be maintained to deal with any chance of fire (Regulation 120 and Circular No. 21 of 1960).

(2) There should be a proper fire-fighting organisation in the mine to deal with any fire (Circular No. 2 of 1960 and Circular No. 59 of 1967).

(3) The stoppings erected to isolate or control a fire or spontaneous heating should be of adequate strength and *maintained properly to prevent any leakage of air or gas through it.* (Regulation 122(4) read with CIM Circular No. 17 of 1964).

(4) Constant watch should be kept on all fire stoppings to check any leakage of air or of noxious gases, and temperature readings should be taken on all stoppings to study the condition of fire (Regulation 122(5)).

(5) Regular air samples should be taken to see if the fire is alive or dead (Regulation 122(3) and Circular No. 15 of 1961).

(6) The surface fan should be provided with a reversing arrangement (Circular No. 2 of 1965).

(2) Accidental Fires

(i) *Underground Fires*

(1) Only the minimum quantity of inflammable materials be stored underground and that only in specially constructed receptacles. Effective steps should be taken to prevent accumulation of oil and grease anywhere in the mine (Regulation 116 and Circular No. 9 of 1960).

(2) All ventilation appliances, and brattice cloth etc. should be made of fire-resistant material. Wherever mechanical ventilators are installed below-ground, the coal sides for a distance of 10 metres in all directions should be properly walled-in by masonry. (Regulation 138 read with Circulars Nos. 6 of 1959 and 8 of 1960).

(3) All conveyor belts, and transmission belts shall be made of fire-resistant material (CIM Circulars Nos. 24 of 1963 and 9 of 1958).

(4) Wood chips, jute cloth used for cleaning oil etc. should not be thrown underground. No timber or other combustible material should be used in the construction of or in connection with any *shaft* lining or any *room housing any machinery or apparatus underground.* Main intake airways should be constructed and repaired with permanent supports and lagging of material which is or has been rendered incombustible (Reg. 118(1) and Circular No. 6 of 1960).

(5) Welding apparatus, blow lamps etc. may be used underground only on special approval of Joint Director of Mines Safety and/or manager. Suitable precautions should be taken when using flame cutting apparatus, oxy-acetylene welding apparatus or electric welding apparatus in shafts, as recommended in Circular No. 55 of 1966. (Regulation 118(2)).

(6) Effective steps should be taken to prevent *illicit distillation* of liquor (Circular No. 4 of 1956).

(7) Precautions should be taken to minimise risk of fire associated with compressed air (Circular No. 17 of 1960).

(8) Preparatory stoppings should be provided in the entries to one or more development districts to isolate any accidental fire etc. in the development workings (Circular No. 62 of 1964).

(ii) *Surface Fires*

(1) All surface structures and supports within a horizontal distance of 10 metres from the entrances to mine should be made of fire-proof material (Regulation 117(1)).

(2) All wild or harbaceous plants ('bontulsi') etc. should be removed from opencast workings and any ground broken by extraction of coal (Regulation 117(3)).

(3) No heated material or ashes should be deposited on any outcrop of coal or any broken ground (Regulation 117(4)).

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(4) No fire should be lighted in any opencast working or within 15 metres from any entrance to a mine except with permission from the manager (Regulation 117(5)).

(5) A zone of at least 15 metres from the *entrances to underground workings* and *the coal face in the* quarry should be kept clean (Circular Nos. 56 of 1964 and 34 of 1966).

(6) Regular inspections by supervisory staff and manager himself should be made to see that precautions against surface fire were being taken (Regulation 117(6) read with CIM Circular No. 32 of 1964).

Coal Mines (Conservation and Safety) Act, 1952

3. *The relevant provisions of the Coal Mines (Conservation and Sefty) Act,* 1952 *and the rules framed thereunder are summarised below* :

(1) Under Section 5 of the Coal Mines (Conservation and Safety) Act, 1952, the Coal Board has been empowered to take such measures as it may deem necessary for effectively dealing with problems relating to safety in coal mines, such as fires, or conservation of coal and matters connected therewith or incidental thereto.

(2) Under Section 13(3) of this Act, an officer of the Directorate-General of Mines Safety or Coal Board may require the management of a mine to undertake such protective measures as deemed necessary to guard against danger of fires, premature collapse or crushing of pillars.

(3) The Coal Board is empowered, under Section 6 of the Act, to execute or cause to be executed under its own supervision measures necessary to deal effectively with an outbreak of fire. In such cases, Board may recover from the management either wholly or partly the cost of such measures or operations if it is satisfied on consideration of all facts and circumstances that such recovery of cost is justified.

(4) The Central Government is also vested with powers under Rule 38 of the Coal Mines (Conservation and Safety) Rules, 1954 to require modifications in method of working of a coal mine or prohibiting depillaring operations, including splitting, if this is considered necessary to prevent outbreak of fire. For this purpose a notice has to be given to the Coal Board under Rule 38(4) by the mine managements before commencing depillaring operations.

(5) Before opening a seam or a section of a seam, necessary permission has to be obtained from Coal Board

under Rule 39. During processing of such applications, danger of existing fires, if any, around the area to be opened is examined as also the method of work.

4. A Coal Mines Safety Conservation Fund has been created under the Act by imposing an excise duty of Rs. 1.65 per tonne on all coal raised and despatched, and Rs. 2.48 per tonne on all hard coke manufactured and despatched from the collieries in India. The Board grants assistance from this Fund to any management of a coal mine for certain purposes, including (1) stowing or other protective measures which are required to be undertaken by an order issued under sub-section (3) of Section 13 of the Act, (2) any measures which in the opinion of the Board are essential for the effective prevention of the spread of fire to any coal mine from an area adjacent to it, and (3) any measures voluntarily undertaken by the management for safety in coal mines or for conservation of coal (*vide* Rule 49 of Coal Mines Conservation and Safety Rules).

5. The form of assistance in which the Board may grant assistance from the Fund could be in one or more of the following ways, amongst others, (Rule 52):

(i) by the grant of stowing materials;

(ii) by the loan of stowing plant or such other plant as the Board may decide;

(iii) by making monetary grants towards the expenses involved in carrying out the measures for which assistance is granted.

6. The relevant provisions of the Coal Mines (Conservation and Safety) Act, 1952 and rules framed thereunder are reproduced at Annexure IV.

IV. REVIEW OF THE PRESENT POSITION

1. There is no doubt that the possibility of spontaneous heating underground can be greatly minimised by adopting proper method of working and complying with the statutory precautions regarding prevention, detection, and control of spontaneous heatings and fires both on the surface and underground. The provisions of the Coal Mines Regulations, 1957, framed under the Mines Act and the various circulars issued in this connection appear to be adequate. The Committee understand that a number of important recommendations of the Director-General of Mines Safety contained in the circulars issued by him on the subject from time to time will be incorporated in the Regulations in due course.

2. The Committee also understand that the new developments of bord and pillar workings are being so laid out as to develop and depillar simultaneously as recommended in DGMS Circular No. 7 of 1966. Alternatively, longwall pattern of work should be adopted, where possible, so that no standing workings are left for long and the loss of coal in goaves is minimized considerably. The aim should be to extract a panel within the period of incubation of the coal. The incubation period is usually regarded as the time elapsing between the occurrence of the first main fall in the depillaring area and the appearance of first signs of heating. The present method of knowing the incubation period is mostly based on practical experience. The incubation period is known to vary from about 3 months in Kajora coal-field to 9-12 months or even more in other coalfields. Detailed research work is therefore required to determine the period of incubation for different coalfields in India and also to assess the relative liability to spontaneous combustion of various coal seams.

3. Improper coursing of air currents and high ventilating pressures play an important part in the initiation of heatings and fires. A low ventilating pressure and a large size return

air-way assist in minimising outbreaks of fire. Research work is necessary to determine the desirable ventilating pressures and sizes of roadways from this point of view.

4. Sometimes development is to be carried out followed by depillaring in a seam which is below a seam suspected to be on fire or which is known to be on active fire. The full extraction of lower seam even with stowing may cause cracks in the intervening strata permitting downward flow of gases and migration of fire from the top to the lower seam. In such cases, the Committee understand that the extraction, of pillars is done only partially with stowing of galleries and slices to prevent the collapse of the strata between the lower and the upper seam. This appears to be a satisfactory method of work.

5. The Committee also understand that a proposal to set up Mine Development Board to which all development plans will be submitted for advance scrutiny and clearance chiefly from safety point of view is under consideration of the Government. The Board will scrutinize the plans to see if the layouts are proper from the points of view of fire hazards and ventilation, percentage of extraction etc. The Committee welcome the proposal and trust that this important measure will further minimise the cases of spontaneous heatings and fires underground.

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6. The main function of the Coal Board in the matter of fire fighting is to initiate prompt action for controlling the fire. Assistance is granted for protective works undertaken by coal mines to guard against such fires and to deal with them effectively. The Coal Board also undertakes protective works directly under Section 6 of the Act where mines have been abandoned or the owners do not undertake the protective measures with the desired promptness.

7. While rules and regulations on the prevention and control of fires are generally adequate, the main problem has been to ensure prompt action to deal with a fire. The chief difficulties that have been experienced in this regard are:

(i) *Notice of Occurrence of Fire*

Lack of timely information to the Coal Board has been responsible for the spread of some fires and delays in starting protective works. At present there is no law requiring the mine managements to inform the Coal Board whenever any incipient heating or fire is noticed in any part of the mine, although for reasons of safety they are required to send such a notice forthwith to the Directorate-General of Mines Safety under the Coal Mines Regulations, 1957.

(ii) *Fires in Abandoned Mines*

Some of the fires had started in old abandoned mines for which there is no machinery at present either in the Coal Board or with the Directorate-General of Mines Safety for requiring measures to be taken to control the fire so that it does not spread.

(iii) *Acquisition of Surface Rights*

Since surface rights are not vested in the Central Government, difficulty has been experienced to tackle surface fires, which otherwise could have been completely dug out expeditiously at the initial stages with the help of heavy earth moving machinery. Due to delay in acquiring surface rights, much valuable time was lost in some cases with the result that the fire got out of control initially and much effort and money had to be spent later on to bring the fire under control.

(iv) *Availability of Heavy Earth Moving Machinery*

Trenching—one of the methods of dealing with a fire—had not been successful in arresting the progress of fire in a number of cases due mainly to the slow speed of cutting the trenches *for* want of availability of heavy earth moving machinery with the Coal Board.

(v) *Powers of the Inspecting Officers to incur expenditure*

According to the existing financial rules of the Coal Board, the local inspecting officers of the Board have very limited powers to incur expenses for dealing with a fire, and even these powers cannot be exercised effectively because of the lengthy and complicated procedure. If large amount is involved then even the Chief Mining Engineer, Coal Board cannot give clearance for starting the protective work, till the case has been examined by the Board's Secretariat and put up to the Coal Board for approval. All this process no doubt takes lot of time with the result that a fire, which could possibly have been dug out and controlled in a matter of few days, becomes extensive. It then takes very much more effort and money to fight the fire, and sometimes it becomes virtually impossible to deal with it once it enters old workings or goaf. There are a number of cases in the records of the Coal Board where such delays have cost several lakhs of rupees when work could have been completed by spending only a few thousand rupees. The entire procedure needs streamlining so that prompt action can be taken to deal with a fire.

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V. NEED FOR RESEARCH

1. Much work has been done and a number of measures have been adopted to prevent the occurrence of fires in coal mines and to control them. The position is now far better than it was in 1930s', when due to bad mining methods a number of large scale fires started which are still active. Despite what has already been done and achieved, need for research to develop more and more effective and efficient methods of detection, prevention, and control of mine fires will always be there, especially under the mining conditions obtaining in India, where most of the seams are thick, liable to spontaneous heating, and are worked on bord and pillars system. It should be recognised that the fighting of a fire in its incipient stage is far easier than allowing it to develop to a stage when extreme measures like flooding or sealing off the openings become necessary at huge expenditure.

2. In the foregoing paragraphs, the directions in which research work may be done had been mentioned here and there in passing. These and other lines, amongst others, along which the research work may be undertaken by the Central Mining Research Station or Central Fuel Research Institute, are outlined below :

(1) Use of steam or liquid carbondioxide as a means of extinguishing fire may be explored to define their scope of application. (Fire hydrant range which is usually installed in mines for carrying water could be utilized to convey CO_2 to flood the area with this non-supporter of combustion).

(2) Scientific determination of period of incubation for different coalfields and to assess the relative liability to spontaneous heating of various coal seams, and the factors that have a bearing on lowering or raising of incubation period including the effect of leakages of air through goaves.

(3) Determination of desirable ventilating pressures and size of roadways for the purpose of assisting in minimising outbreaks of fire.

(4) Use of foam plug technique of fighting mine fires, which has been tried in other countries with varying success.

(5) Spraying of conventional brick stoppings, sand bag and brattice stoppings, packwalls etc. with rigid polyurethane foam or latex sealant, which has been tried in U.S.A. and U.K. with some success.

(6) Use of inflatable stoppings for quick isolation of incipient heatings, and effective sealing of such stoppings.

(7) Development of a fire-resistant material which when thrown on a raging fire expands many times its original volume due to certain pyrochemical reactions.

(8) Use of inhibitors to reduce the liability of coal to spontaneous heating as have been tried in U.S.S.R. (It appears that sodium silicate, and all petroleum products and their emulsions protect coal from oxidation. Recently, encouraging results were obtained by Central Fuel Research Institute by applying a 4-8% solution of sodium silicate to coal surface of pillars in two mines, where there had been incidents of fire in solid coal pillars. Further research work is in progress).

(9) Other practical methods of fire control.

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VI. RECOMMENDATIONS

1. Having reviewed the past coal mine fires and the prevalent methods and practices of preventing and controlling them; the problems of enforcement and implementation of statutory and protective measures; and the need for research into new processes and methods of detection, prevention and control of mine fires; the Committee make the following specific recommendations to strengthen and augment the efforts of the Government authorities and the industry in minimising and limiting the effects of mine fires :

(1) The method of working of coal seams should be such that it minimises the risk from fire, and in the event of heating or fire taking place it is possible to isolate the affected part quickly. In this context, the setting up of the proposed Mines Development Board should be expedited, as it will have adequate powers to control and enforce the desirable methods of working (Section IV Para 5).

(2) When there occurs in or about a mine a spontaneous heating or outbreak of fire, or appearance of smoke or other indication of heating or outbreak of fire, it should be made mandatory on the mine managements to inform the Coal Board forthwith just as they report at present to the Directorate-General of Mines Safety. (Section IV Para 7(i)).

(3) The Coal Board should have powers to enter the premises immediately and later acquire, if necessary, the surface right in coal mines in which fire has occurred, so that the task of digging out or controlling the fire is expedited. (Section IV Para 7(ii) & (iii)).

(4) Heavy earth moving and other suitable machinery and equipment should be available to the Coal Board to deal with a fire on the surface or for sealing the surface speedily and effectively. (Section IV Para 7(iv)).

(5) The Chief Mining Engineer and the local inspecting officers of the Coal Board should be vested with adequate financial powers to deal with a fire as soon as it has been brought to their notice so as to initiate immediate action in consultation with Directorate-General of Mines Safety. In this context, the whole administrative procedure including calling of tenders etc. should be streamlined so that prompt action can be taken to deal with a fire. (Section IV Para 7(v)).

(6) (a) Systematic research should be done for newer methods of prevention, detection and control of mine fires as would be of practical use under Indian Mining conditions. For this purpose, the Coal Board should earmark a specific annual grant from the Coal Mines Safety and Conservation Fund under Rule 56 of the Coal Mines Conservation Safety Rules, 1954.

(b)There is also an urgent need to develop new methods of extraction of thick seams along with fire control methods like flushing with mud or fly ash etc. For this purpose, Coal Board should give assistance, wherever necessary, for developing such methods. The Board should also subsidise extraction of thick seams by opencast method which would give more or less cent per cent extraction and reduce hazards of fire. (Section V Para 1).

(7) Suitable penal provisions should be incorporated in the Coal Mines (Conservation and Safety) Act, 1952 so that the orders or directions issued on owner, agent or manager of a mine under Section 13 of the Act are deterrently actionable if they are disregarded by a mine management.

(8) Whenever the Coal Board has to step in and fight a mine fire on its own due to inaction on the part of the owners, the entire cost or part thereof on protective works should be recovered from the

owners of the colliery. If necessary, the Board should be vested with requisite powers to recover the amount as arrears of land revenue.

(9) Construction of unauthorised buildings and structures on fire area or areas which are likely to be affected by fire should be prohibited with the assistance of State Governments.

(10) There should be adequate publicity by means of documentary films, posters etc. in order to impress clearly and effectively upon all concerned, the dangers to life and property which mine fires entail, the causes which start a mine fire, and the methods of preventing and controlling them.

(11) For proper study of each case of fire, a record should be kept in the Coal Board containing *inter-alia,* the following particulars :

(1) Cause of the fire.
(2) Date of occurrence.
(3) Date of reporting the fire.
(4) Action taken to control the fire.
(5) Duration of the time taken to complete the protective work.
(6) Amount of coal lost in fire.
(7) Amount of coal sterilised temporarily due to fire.
(8) Total expenses involved in dealing with the fire.
(9) Any features of fire requiring special attention.

(12) The position about occurrence of mine fires, and steps taken to minimise their number and effect may be reviewed once in every five years.

Dr. K. N. Sinha and Shri. A. K. Mitra have not agreed to to certain portions of the report and have given their notes of dissent which are given in Appendices I & II. Dr. K. N. Sinha has made certain additional recommendations in his note.

APPENDICES AND ANNEXURES

APPENDIX-I

Note of dissent, including additional recommendations, by Dr. K. N. Sinha, Director, Central Mining Research Station

(1) The origin of the fires in each case should be determined by Coal Board whether it is associated with opencast mining or with underground mining coupled with surface subsidence or underground mining without surface subsidence. The determination of time lag between the following stages will go a long way in usefully guiding the future line of action in this respect.

(a) occurrence of the fire

(b) reporting of the fire to the competent authority

(c) effective action initiated to control fire

(d) the duration of time taken to complete the protective action taken.

(2) The damage to the land after mining operations either by opencast mining or by subsidence associated with underground mining should be examined. The State Government (which collects the royalties and requires the mine management to acquire the land on payment which is damaged by mine workings) should be approached to spend a part of the royalty for restoring the land damaged by mine working for its future use either for cultivation or for plantation or habitation.

(3) The cases of the mines working by underground mining in the areas where the cover is such that surface cracks are likely to develop and they are likely to feed the mine fire by atmospheric air, should be examined by the Coal Board. In such cases, the possibility of (a) opencast mining, (b) steps to be taken to immediately fill up the surface cracks should be considered and (c) steps to be taken to avoid surface cracks.

(4) The Forest Departments of the State Governments concerned should be approached to plant species of plantation

which will in due course completely eliminate growth of 'Bontulsi' in mining areas, particularly in and around the goaves.

(5) The position regarding coal mine fires in India should be reviewed every five years by a committee, say, next in 1970. The action should be initiated by Planning Commission. This task could also be entrusted to the committee proposed in the next paragraph.

(6) There should be a single authority or committee to which all collieries will submit their plans for development and extraction either by depillaring or by longwall mining. These plans should be detailed ones and *time-targetted*. They should be drawn in broad outlines 10 years in advance and in details 3 years in advance. They should be submitted for approval, say, 2 years in advance of starting the operation, and collieries should get back the approval within 6 months of their submission. Wherever necessary, the committee might call the party concerned for discussion before taking final decision. The recommendation of the committee should be implemented both by the Coal Board and the Chief Inspector of Mines under their statutory powers. There need not be any apprehensions regarding the recommendations of this committee being in conflict with statutory duties of Chief Inspector of Mines and Coal Board since both these organisations will be fully represented in the committee. This committee need not have a member from the mine management. The mine management will get a chance of presenting its own case to the committee when invited to do so and wherever it is found necessary. This committee should consist of 4 members and each member will act as Chairman by rotation every year. The Secretariat facilities for this committee should be provided by the Coal Board under whose auspices this committee should function. The members of this committee should be (1) Director, Central Mining Research Station, (2) Chief Mining Engineer, Coal Board (3) Chief Inspector of Mines, and (4) Director, Indian School of Mines.

The members (1) and (4) will act as experts in the committee unbiased by the prejudices of the working of the statutory powers and bring to the committee the latest development in the field in respect of research in India and abroad and the advancement of knowledge and free thinking. The plans submitted by the parties concerned should be detailed ones and should cover mining in all its aspects keeping in view the indigenous production of mining machinery. •

(7) It should be the responsibility of the Coal Board to take up steps and fight coal mines fires immediately on receipt of the information. They may take the assistance from the local management, if it is available. In case where such assistance is not available, they should take up the whole work on their own. The Coal Board will later decide about the amount which should be reimbursed by the Coal Company. There should be a *single authority* to take complete charge of the mine fire and act independently and expeditiously from the first stage of receiving report till the last stage of controlling the mine fire and such an authority should be the Coal Board only because, eventually, they have to stand the bill of assistance.

(8) The Coal Board, which is the body primarily entrusted with the responsibility of conservation of coal and safety in coal mines, should be statutorily empowered to require all collieries to submit their development and other working plans for approval so that wherever necessary the Board can issue directions designed to minimise fire risks in coal mines.

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(9) The preparation of accurate plans of all fires whether on the surface or underground and their submission in time to the Coal Board be a mandatory obligation under Coal Mines (Conservation & Safety) Act 1952 to the owner, agent or manager of a coal mine.

(10) A cyclostyled note entitled "Protective works undertaken by Board Departmentally" circulated by the Secretary, Coal Board as the enclosure to his letter No. PA-54 of July 3/5, 1965 on the subject of Report of the Committee on Coal Mines Fires and Methods of Mine Working giving the work done at various collieries (a copy of this statement is reproduced below), should be incorporated as an Appendix to the

Report. This note contains valuable record of contribution made by the Coal Board.

(11) Section IV Para 4 of the report states: "Sometimes development is to be carried out followed by depillaring in a seam which is below a seam suspected to be on fire or which is known to be on active fire. The full extraction of lower seam even with stowing may cause cracks in the intervening strata permitting downward flow of gases and migration of fire from the top to the lower seam. In such cases, the Committee understand that the extraction of pillars is done only partially with stowing of galleries and slices to prevent the collapse of the strata between the lower and the upper seam. *This appears* to be a satisfactory method of work".

This method, though satisfactory from the point of view of safety, entails loss of coal. Therefore intensive research is necessary to enforce the possibility of introduction of new methods of extraction in such a situation.

(12) I am in disagreement with Section IV paragraph 5 and Section VI paragraph 1(1) which refer to the proposal to set up a Mines Development Board and the recommendation that its setting up should be expedited, as it will have adequate powers to control and enforce the desirable methods of working. The Committee has received no proposal or note regarding formation of Mines Development Board. In the absence of any detailed information about the composition and the functions of the proposed Board, it is difficult to offer any comment. Moreover, the proposal, even if there be any, needs careful examination as already several powers as are sought to be assigned to the proposed Board are already within the purview of the Coal Board.

Protective Works Undertaken by Coal Board Departmentally

1. Section 6 of the Coal Mines (Conservation & Safety) Act, 1952 lays down that if in the opinion of the Board, it is necessary or desirable that any measures, including stowing, required in furtherance of the objects of the Act should be undertaken directly by the Board, the Board may execute or cause to be executed such measures under its own supervision.

Some of the cases in which the Board has had to step in to fight fires or floods in coal mines are detailed below:—

Jogata Colliery

This is an old fire dating back to 1930 or even earlier in XI, XII, XIII & XIV seams which initially started due to premature collapse of some coal pillars in XIII and XIV seams. Various instructions of the Chief Inspector of Mines given to the colliery to construct fire stoppings, blanketting drill boreholes and flush sand, were initially undertaken by the colliery with assistance from the Board. In 1962-63, however, when the coal company expressed its inability to undertake further work unless the Board sanctioned 100% assistance in place of the usual 85% the Board decided to take over the major works of blanketting and of drilling boreholes and flushing sand through them, departmentally. The Board's stepping in at the late stage has not yet resulted in extinguishing the fire, although it has been controlled in so far as the fire has been prevented from crossing to neighbouring collieries (through measures already taken and still being taken). The Board has during last 3 years sanctioned a total of approximately Rs. 11 lakhs for the departmental works.

Pure Jharia

Fire was noticed in X seam in 1960 and the company was granted assistance to deal with it by pumping water over the fire. By 1961 the fire had assumed alarming proportions so much so the owners abandoned the mine, leaving valuable machinery etc. to be destroyed. While the colliery could not be saved, it was left to the Board to prevent the fire from spreading to neighbouring collieries to ensure which the Board has undertaken controlled flooding in the Pure Jharia Colliery (and for which total sanction to date is Rs. 3 lakhs) and excavation of a trench between Pure Jharia and the Dobary Collieries, costing approximately Rs. 12 lakhs. This trench is being cut for the last 3 years by manual labour.

Dhariajoba

The fire, in an abandoned mine, occurred in 1962 due to illicit distillation operations. It was left to the Board to fight the fire for preventing it from crossing over to the neighbouring Busseriya, Bansdeopur and West Godhar Collieries; the fire could also have affected the stability of the Kusunda Railway Yard. The fire has been controlled.

Ekrakhas

A fire on the south side originated in 1928 due to spontaneous combustion and gradually affected the southern portion. Then another fire started in 1954 on the northern side in some crushed pillars and the owners of this colliery were granted assistance for dealing with fire from 1954 onwards but they failed to do the work expeditiously with the result that the fire spread to all parts of the property and threatened neighbouring Loyabad, Sendra Gopalichuck, Central Kirkend and various other collieries. The owners of the colliery having expressed their inability to undertake the necessary protective works, the Board was obliged, in the interests of safety and conservation, to step in and take up the work which included, *inter alia*, controlled flooding on the north and south of the property, filling up of quarry edge with sand and earth and surface blanketting were required. The work is still continuing.

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Lakurka

The history of this case is well-known and briefly is that the colliery which had been asked by Chief Inspector of Mines & Board to cut a trench for isolation of fire and to spray water on open fire to keep it under control went about the work in such a leisurely fashion that on stoppage of the work on account of labour disputes the Board had to take it up when it was found that the fire had already crossed the half-dugtrench, thereby rendering all the work done till then infructuous. Back-filling of the trench has been completed by the Board as well as the work of creating artificial pools of water over the fire area terraced where necessary to prevent breathing. The colliery was asked to construct a large number of fire stoppings in the mine which are yet to be completed.

New Jemehari Khas

Packing work under Railway siding ordered by Chief Inspector of Mines was carried out by the colliery in such a slow manner that although three years have gone by, only a part of the work has been done. In the mean time fire aggravated and the Board has recently been forced to take up the necessary protective works.

Lodna

The colliery has been cutting trenches all around its property to prevent fires from crossing over to it from K. B. Seal's Suratand, Benehir, Upper Lodna, New Suratand etc. The Board has been granting assistance for the work for the last 3 years but the progress has been poor.

Karkata

The colliery has been cutting an isolation trench for 3 years without even completing a quarter thereof. Board is currently examining whether the work should be taken up departmentally.

Bhowrah

Trenching & blanketting work being undertaken in XIII & XIV seams is going on for the last 2 years. Work has not been completed and company has been asked to stick to its schedule.

Khas Ganespur

The owner decided to abandon the mine when the IX seam was downgraded. Chief Inspector of Mines instructions to carry out protective works before closing the mine were taken up by the company as the Board's contractor but even there it failed to complete all the work. In the meantime due to a collapse in the X seam of Ganeshpur Colliery immediately below, the mine was ordered to be closed.

2. There are many more examples, but the above will give an idea of what the Board has to tackle.

APPENDIX-II

Note of dissent by Shri A. K. Mitra, Chief Mining Engineer, Coal Board

(1) *Page* 25 (*Section IV, Para* 5)

This paragraph relates to the setting up of a Mine Development Board which will scrutinise all development plans of mines and give clearance from safety point of view. The Coal Mines Conservation & Safety Act, 1952 is an Act to provide for the conservation of coal and make further provision for safety in coal mines, Annexure IV gives a resume of all important Sections of the Act and Rules relating to conservation and safety aspects and from this it would be seen that Section 7(1) of the Act and Rule 38(2) already provide ample power for the Central Government to regulate development of mines and these powers have been delegated to the Coal Board. As such the proposal to set up a Mine Development Board will be conflicting with the functions of the Coal Board and would result in a mere duplication of the Board's work.

(2) *Page* 26 (*Section IV, Para.* 7(*v*))

The Coal Board is the agency for dealing with protective works necessitated by fire and/or inundation. Financial rules should be relaxed to the extent to enable undertaking of protective works as soon as they have been brought to the notice of the Board and necessary powers to achieve this objective should be delegated to the Chief Mining Engineer, Coal Board.

The statement that there are a number of cases in the records of the Coal Board where delays have cost several lakhs of rupees where work could have been completed by spending only a few thousand rupees is not borne out by the facts.

(3) *Page* 28 (*Section VI, Para.* 1(1))

The Coal Board on adequate statutory power vests to control the methods of workings should rigidly set out the pattern of exploitation of coal seams with an idea to achieve conservation/safety and avoidance of fire and other dangers. If need be, the Board's technical wing should be suitably strengthened to take up this additional duty. There is no need to have a Development Board separately for this work as multiplicity of organisations will only result in more confusion, infructuous expenditure and work and overall harm to the industry.

(4) *Page* 29 (*Section VI, Para.* 1(5))

The Chief Mining Engineer of the Coal Board should be vested with the financial powers to spend upto Rs. 1 lakh to deal with a fire as soon as it has been brought to his notice and he should initiate scheme in consultation with the D. G. M. S. Delays on account of calling of tenders and other formalities should be done away with and rates should be fixed on the basis of prevailling rates in the market for such work.

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ANNEXURE-I

Circulars issued by the Director-General of Mines Safety, (formerly Chief Inspector of Mines) on the prevention and control of Coal Mines Fires and regarding Methods of Mine Working.

Copy of Circular No. 4 of 1956 dated 27th Feb., 1956

Danger of Fire

A number of cases of illicit distillation of liquor in the underground workings of a mine have brought to my notice. You will realise that this pratice is likely to lead to extensive fires underground and therefore, must be stopped. Particular attention to this aspect should be paid during inspection of old workings. In case of workings which are not inspected regularly the entrances from the surface should be permanently closed across the whole width in such a manner as to prevent unauthorised persons entering into the workings. The entrances should be inspected at regular intervals.

Any person found to be carrying on such distillation should be immediately reported to the nearest Excise Officer. If such persons are employees of the colliery, suitable departmental action should be taken against them.

Your attention is also invited to Temporary Regulation 7(4) regarding danger of fire from wild growth of vegetation.

Copy of Circular No. 9 of 1958 dated 2nd June, 1958

SUBJECT: *Conveyor belts for use underground.*

This is to bring to your notice that, under sub-regulation (4) of Regulation 92 of the Coal Mines Regulations 1957, this department will not permit conveyor belting to be installed below-ground unless the belt is of a fire-resistant type.

Any belts already installed belowground will, however, be permitted to continue to be used. An exemption may also be granted in respect of the use of rubber belting purchased by the colliery company concerned before 30th June, 1958.

Copy of Circular No. 6 of 1959 dated 19th Feb. 1959.

Precautions against Fire

In a recent case, one of the bearings of a main mechanical ventilator installed belowground before the coming into force of Coal Mines Regulations, 1957, became hot, resulting in the drive belt catching fire before the fire could be detected. The electric winding of the drive motors got burnt and the timber used in the vicinity of fan also caught fire as also the coal in the pillar sides. All persons working underground had to be withdrawn to the surface and the services of the Rescue Station had to be requisitioned before the fire could be put out.

This case brings out the advisability of siting the main mechanical ventilators on the surface even though a mine may be a non-gassy one. Managements of all mines having main ventilators installations belowground are hereby advised to explore the possibility of shifting the mechanical ventilator to the surface.

Whenever mechanical ventilators are installed belowground it is also necessary that the coal sides for a distance of 10 metres in all directions be properly walled in by masonary.

Copy of Circular No. 2 of 1960 dated 6th January 1960

Fire-fighting equipment and Organisation

1. Whenever in a mine fire-fighting equipment is provided in accordance with clause (5) of sub-regulation (2) (b) of the Coal Mines Regulations, 1957.

(a) Water piping (including joints) should

(i) as far as practicable, be of metallic construction throughout; and

(ii) Hose connections should be standardised throughout the mine.

2. In every mine where fire-extinguishers are provided, a sufficient number of persons, especially machine operators and Khalasis, should be trained in the use of these fire-extinguishers.

3. In order to prevent accidents due to fires in coal mines, it is also necessary that a proper organisation for fighting fires should exist at every mine. For this purpose, fire-stations should be established at surface and also on every main haulage roadway belowground at suitable places in the intake air current near a main shaft. Adequate fire-fighting equipment should be kept in every such fire station.

4. A sufficient number of plans showing the fire-fighting equipment maintained at the mine, and giving such other information as may be useful for the purpose of fighting fires should be prepared and up-to-date copies of these plans should be kept available at suitable places both on the surface and belowground.

5. Adequate number of persons should be trained in fire fighting. Such persons should be familiar with the position of all fire-fighting equipment provided in the mine in general and near their places of work in particular.

6. The manager of every mine should also draw up Standing Orders laying down the procedure to be adopted for giving warning of fires, for withdrawal of personnel from the mine and for the conduct of fire-fighting operations. The standing orders should be sent to the undersigned for approval.

Copy of Circular No. 6 of 1960 dated 13th Jan. 1960

Use of incombustible material near shaft landings etc. and in main intake airways.

For preventing accidents due to fires below-ground in coal mines, the International Labour Office has recommended that underground shaft landings, roads and other places (with doors and other fittings in them) connected to shafts should be of incombustible construction or be effectively treated or covered so as to be incombustible, upto a distance of at least 75 metres from the shaft. It has also recommended that main intake airways should be constructed and repaired with permanent supports and lagging of material which is, or has been rendered, incombustible.

These recommendations are hereby brought to the notice of all concerned for compliance.

Copy of Circular No. 7 of 1960 dated 14th Jan. 1960

Prevention of danger from spontaneous heating

The precautions given below should be observed to prevent danger from spontaneous heating.

Precautions against occurrence of spontaneous heating.

(a) Development should be made in panels having independent ventilation in such a manner that it is possible to isolate one from another easily, if necessary, where development has already been made without regard to this factor, artificial panels should be made out.

The panels, should be as far as practicable, be of such a size as to permit complete extraction within the incubation period.

(b) All fallen coal should be removed promptly and completely. Where its removal is not practicable, fallen coal should be sealed by slushing with sand, injection of cement or other effective means. (This does not, however, apply to coal that is in the course of spalling off the sides but has not fallen off.)

(c) A panel shall be isolated by adequate stoppings as soon as it is goaved out.

2. *Material for extinguishing spontaneous fires:* Sufficient material for extinguishing fires by slushing, guniting, injection of cement or other effective means should be kept in

readiness of suitable places for transport and use. A sufficient number of persons should be trained in the use of this material.

3. *Detection of spontaneous heating:* In order that spontaneous heating is detected at its early stage, the air in the return airway of every depillarin district, and of every goaf which has not been isolated, should be :

(a) tested at least once a day with an officially approved carbon monoxide detector; and

(b) completely analysed at least once in every 7 days with a view to determining the ratio to formed Oxygen absorbed.

If successive tests show any steady increase of this ratio, measures should be taken to determine the site of the heating and, if practicable, to suppress it.

The district should also be inspected on every idle day by a person holding the overman's certificate.

Copy of Circular No. 8 of 1960 dated 15th Jan. 1960

Brattice cloth and brake linings etc. to be fire-resistant.

For preventing accidents due to fires belowground in mines, it is necessary that the use of brattice cloth should be avoided as far as possible. If brattice cloth has to be used, it should be fire resistant or should be constantly maintained in a wet condition.

With the same object, it is also necessary that brake-linings and sheave packins of haulage engines and winches should be incombustible.

Copy of Circular No. 9 of 1960 dated 16th Jan. 1960

Prevention of accumulation of grease on headgears etc.

For preventing accidents due to fires belowground, the International Labour Office has recommended that inflammable material such as oil and grease etc. (and coal dust also in coal mines) should not be allowed to accumulate to a dangerous extent anywhere in or about the mine and, in particular, on headgears and shaft buildings, in shafts and in underground places where mechanical equipment or electrical equipment is installed.

The recommendation constitutes an important precaution against the danger of fire and is hereby brought to the notice of all concerned for compliance.

Copy of Circular No. 17 of 1960 dated 30th March 1960

In order to minimise the risk of fire associated with the use of compressed air, the following precautions are suggested. They may please be brought to the notice of all concerned for strict compliance.

"1) Leakage in pipe joints particularly the type that produces a sequel leads to fire. As far as practicable plans flanged joints in the pipe range should not be used. Only non-inflammable packing materials should be used at the joints.

"2) Sealing of holes in pipes by packing should not be done. Only clamps of robust construction in conjuction with non-inflammable material should be used.

"3) A compressed air pipe range should not be kept buried.

"4) A punctured hose should not be used."

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Copy of Circular No. 21 of 1960 dated 26th April, 1960

SUBJECT : *Provision of Fire Extinguishers underground.*

In order to deal with accidental fire underground, it is suggested that for the purpose of Regulation 120 (1) portable fire extinguishers of Minimax 'Frowave' type (fully sealed model) or of any other similar type should be provided at every entrance to a mine, at every landing and shaft bottom in use, on pumping and other machinery in shaft lodgments; at intake entrances to engine houses and sub-stations; on the intake side of gate and switch-gear, and at approximately 10 yds. on the intake side of conveyor transfer and loading points; on or near portable machines or motors, and on the intake side of semi-portable or fixed machines or motors; and wherever timber canvas, grease, oil or other inflammable material is stored.

Although the foam type extinguishers referred to above are sometimes in emergency against fire involving live electric circuits, their use is not without some degree of risk to the operator. For the purpose of use upon electrical fires, therefore, it is recommended that carbon-dioxide gas or the dry power appliances should be used at places where electrical equipment and gear are installed.

Copy of Circular No. 23 of 1960 dated 20th May, 1960

SUBJECT: *Cable for shot-firing.*

It has been brought to my notice that, at a number of mines, cables of a very filmsy nature are being used for shot-firing. In many cases, their insulation is not efficiently protected from mechanical injury in terms of the provisions of Rule 123(1) of Indian Electricity Rules, 1956.

It is highly essential that, for use in shot-firing, a cable should be well insulated as well as protected from mechanical injury. It is advisable to use, for this purpose, a two-core cable, each core consisting of a conductor of at least four copper wires of not less than 0.012 inch diameter, with insulation and further protection against mechanical wear and damage not less than that:—

(a) of PVC (Polyvinyl Chloride) 0.025 inch in thickness with a figure-eight construction.

(b) of valcanised rubber or PVC 0.020 inch in thickness, the two cores twisted, warmed and covered with a sheath of cotton braid, tough rubber or P.V.C.

Copy of Circular No. 15 of 1961 dated 15th May, 1961

SUBJECT : *Taking samples for ascertaining atmospheric conditions behind stoppings built to seal off heating etc.—Coal Mines Regulation* 122(3).

Sub-regulation (3) of Regulation 122 of the Coal Mines Regulations, 1957 requires that in every mine where a fire exists below ground and in every gassy mine, arrangements shall be made once at least in every 30 days to ascertain the atmospheric conditions behind the stoppings built to seal off an area of whole workings or a fire or spontaneous heating unless such stopping are capable of resisting the force of an explosion. It has come to my notice that samples for this purpose are often collected indiscriminately without regard to the barometric conditions. It would be apparent that such samples would reflect the true state of affairs only if they are taken during periods of low barometric pressure, such as between the hours of 12 A.M. and 2 P.M.

It is also important for comparison purposes that, as far as practicable, the sample from a particular stopping should be collected on every occasion at the same time.

Copy of Circular No. 41 of 1962 dated 22nd Aug. 1962

SUBJECT : *Provision of Isolation/Preparatory Stoppings around depillaring areas—Regulation* 100(4).

As you are aware, before commencement of depillaring operations (with caving system and sometimes even where stowing is done) isolation stoppings are to be provided in all the openings other than the openings essential for ventilation, haulage etc. around the area to be extracted. While granting permission for depillaring special attention is also always invited to the provisions of this regulation for strict compliance. It has however been noticed that in a number of cases depillaring operations had been started without completing the required number of isolation/preparatory stoppings.

Since the provision of the stoppings is an essential precaution against danger from fire, it is proposed that, when a proposal for depillaring is approved in principle by this office a letter would at first be issued to the management concerned intimating that the work of building the isolation/preparatory stoppings may be started and the Regional Inspector of Mines may be informed as soon as the work is completed. The letter granting permission for depillaring (subject to such other conditions as may be considered necessary) would be issued from this office only after the stoppings have been provided to the satisfaction of the Regional Inspector of Mines.

Copy of Circular No. 55 of 1962 dated 23rd Oct. 1962

SUBJECT : *Provision of Isolation/Preparatory Stoppings Regulation* 100(4).

Under Regulation 100(4), before the commencement of depillaring operations, isolation/preparatory stoppings are required to be constructed in all the openings as a precaution against an outbreak of fire. No such stoppings are however, required to be built where the voids formed as a result of extraction of pillars are packed with incombustible materials

There have been cases of outbreak of fire or heating even in mines where extraction of pillars was being done in conjunction with stowing with the result that all the workings had to be abandoned and sealed for an indefinite period. It is now considered advisable that even where the extraction of coal is done in conjunction with stowing, isolation stoppings should be, provided so as to avoid the eventuality of the whole workings in a seam having to be abandoned in the event of an outbreak of fire or heating. However, whereas the isolation/preparatory stoppings are to be built for each panel where extraction of pillars is done with caving system such stoppings may be provided to enclose more than one panel where depillaring is to be done with stowing.

In view of the foregoing remarks, it is desired that while submitting an application for depillaring (with or without stowing/packing), the manner of isolating part(s) of the mines proposed to be depillared should be mentioned in the application and indicated on the plans accompanying the application.

Copy of Circular No. 9 of 1963 dated 18th Feb. 1963

SUBJECT : *Depillaring operations: Information about local and main roof falls.*

It has been found that generally no information is available at the mines with regard to the date of first/local roof fall in the panel under extraction and the date(s) of main roof fall(s). It would be appreciated that this information can be very helpful in determining the behaviour of the roof in the mine and give a clearer idea about the incubation period of the seam(s) being depillared. It is, therefore, recommended that a proper record of the following information in respect of each depillaring panels, if any, in the mine should be kept in a paged book specially maintained for the purpose :—

(i) Date of commencement of depillaring operations in the panel.

(ii) Roof area of the standing goaf.

(iii) Date(s) of first/local roof fall.

(iv) Date(s) of main roof fall.

Copy of Circular No. 24 of 1963 dated 28th March, 1963

SUBJECT : *Use of transmission belts underground: Precautions against fire.*

It has been brought to my notice that in some mines rubber transmission beltings (V-belts etc.) are in use underground for driving fans etc., and that they are not of fire-resistant type. Since such types of beltings can be a source of fire which may be disastrous in an underground mine, it is recommended that all such belts should also be of the fire-resistant type.

The beltings which are already in use and which are not fire resistant should be replaced immediately in gassy mines, and as early as possible in all other mines.

Copy of Circular No. 37 of 1963 dated 25th March, 1963

SUBJECT : *Isolation stoppings in mines carrying out depillaring operations in conjunction with stowing.*

Though the possibility of outbreak of spontaneous heating is much less during extraction of pillars with stowing compared to that during extraction of pillars having caving system, some cases have recently occurred where, even in stowing mines, spontaneous heating occurred and the whole mine had to be sealed off resulting in serious losses of coal and material as well as of employment. It is therefore, advisable that even in seam where depillaring operation is being carried on in conjunction with stowing, panels are formed (with preparatory stoppings fitted with doors) so that these could be isolated in case of an emergency. Such panels may not be as small as are necessary in mines where pillars are extracted with the caving method, but may be much larger. The precaution however, is very necessary to ensure that if spontaneous heating does take place in a mine worked in conjunction with hydraulic stowing, the whole mine does not have to be closed down.

Copy of Circular No. 16 of 1964 dated 29th April, 1964

Advance scrutiny of Mine Projects

In its report on Standards of Mines Ventilation, the Technical Committee on Mine Safety Standards appointed by the Government of India, has recommended *inter alia* that "there is great need for advance planning of all mine projects with a view to ensure that the ventilation aspects receive due consideration from the very initial stages." The relevant extract from the Report (which is being published separately) is attached.

Action is being initiated by the Central Government to amend the Mines Act to provide for the setting up of Mine Development Board for advance scrutiny of all mine projects from the safety view point. Even before such a board is set up, however, it will be in the interest of mine management themselves to send a copy of all new mine projects to this office for such scrutiny-particularly from the ventilation point of view. Existing mines should also draw up their plans for development and extension of workings at least three years in advance, and submit copies of the same to this office for scrutiny. This would also enable these managements to give thought to obtain timely permission for working under restricted areas or in respect of their depillaring programmes —as advised in this office circular No. 19 of 1960.

Extract from Report of Technical Committee on Mines Safety Standards of Mine Ventilation

39.1. There is also great need for advance planning of all mine projects with a view to ensure that the ventilation aspect receives due consideration from the very initial stages.

In this connection it may be pertinent to recall the following comments made in 1959 in respect of ventilation planning in British Mines by the Bryan Committee.

"Whatever the particular problems presented by individual collieries may be the important general requirement is that there should be a plan, and that the colliery ventilation system should not be merely the result of expedients progressively adopted as the workings advance. The capacity of the fan and the ventilation layout should be selected having regard to the highest duty it will be required to perform, and the colliery officials should be fully conversant with the overall development plan for the ventilation of the colliery, both as a whole and especially as it effects the particular part of the pit for which they may be responsible. In our view there is considerable advantage to be gained by including ventilation amongst the items covered by the general development plan for a colliery and which cannot be altered subsequently in any major respect without the arrangement of (concerned interests)".

"It is important that the efficiency of ventilating systems and all their equipment is kept under close review to ensure that they are actually achieving what they are intended to achieve and to effect any alternations necessary in the light of changing circumstances."

39.2. Till about 30 years ago, ventilation in Indian mines was not a major problem except in the ultradeep mines of Kolar. As the workings became deeper and generally more gassy, however, difficulties arose in this respect. The average depth of the mine workings in this country is steadily increasing and in general, the firedamp emission per tonne of coal mines is also increasing. In order to avoid ventilation difficulties, arising later on, therefore, the necessity of planning the ventilation system well ahead has become more and more evident and indeed must now be accepted as a merely good mining practice.

The greater depth of mining also gives rise to higher strata temperatures with resulting higher air temperatures in the working places, which again calls for advance ventilation planning and possibly in due course, for some form of air conditioning, much as is already being practised in the Kolar gold mines.

39.3. The average daily output of Indian mines is also increasing, and still larger outputs are being planned necessitating the provision of larger volumes of circulating air and of higher fan water gauges. "It now becomes essential to look many years ahead when considering the installation of main fans for these mines, whether existing or projected, in order to ensure that the fan will meet the full ventilation requirements of the colliery, for as far ahead as can be reasonably foreseen. Furthermore, the ventilation requirement may change appreciably during the successive stage of development of the mines—all of which must be considered when preparing the fan specification if the fan is to operate with a reasonable degree of efficiency throughout all the stages of development and workings".

39.4. Though the safety aspect of ventilation is generally well appreciated, the economic aspect has not received the same attention, and indeed, sometimes it appears almost to have been forgotton. The mine is rarely visited by the senior officials; and large volumes of leaking air, serving no useful purpose, may be heard but cannot be seen. The main fan operates 60 minutes per hour, 24 hours per day and 365 days per year. The cost of providing the ventilation system and the constant provision of adequate quantities of air may be quite big at a large mine today and even a 5% drop in ventilation efficiency can mean a loss of thousands of rupees at the end of the year.

Thus, in a mine in which 1,50,000 ft./min. of air is circulating at 1 inch water gauge, the cost of power alone comes to over Rs. 28,500 per year assuming a mechanical efficiency of 90%, a fan efficiency of 60% and an industrial rate of 10np. per unit of electricity. If this fan efficiency could be increased to 70% the power cost would come down by Rs. 3,700 per year. In addition, of course there are costs of depreciation and maintenance as well as labour costs.

To ensure that the ventilation system is the most economical possible it should not be allowed to develop haphazardly, but must be properly planned having in mind the future development of the mine, the layout of the working, and the method of working to be adopted. As no mine ever develops precisely as planned, but the ventilation system must be reasonably flexible and must be amended as occasion arises.

40.1. The committee understands that provision is being made in the Mines Act for the setting up of a Mine Development Board for scrutiny of all mine project plans. The Committee feels that the proposal brooks no delay if only to ensure that adequate attention is paid to the Ventilation aspect of the mine at its planning stage.

Copy of Circular No. 17 of 1964 dated 30th April, 1964

SUBJECT: *Specifications for ventilation and Isolation stoppings.*

It has been observed that different specifications are being followed by mines while building ventilation and isolation stoppings. In some cases it has been seen that the isolation stoppings were not properly locked into roof, floor or sides with the result that they did not effectively seal off the area. A few cases have also come to the notice of this office where the isolation stoppings were built with bricks-in-mud, and pointed with lime & cement. This again is not a satisfactory method of constructing isolation stoppings.

The regulations do not give details of the manner in which ventilation and isolation stoppings should be constructed to serve the purpose for which they are meant. The following standards are therefore recommended to be followed in this regard.

Ventilation Stoppings: Thickness and Construction.

1. (a) The minimum thickness of a ventilation stopping should in no case be less than 38 centimetres (15).

(b) The stoppings should be pucca built in lime or cement mortar.

Prevention of leakage.

2. The stoppings should be plastered on the outside with sufficient thickness of lime or cement plaster to prevent leakage of air.

Isolation Stoppings:

A. Non-Gassy and Technically Gassy Mines: Thickness and construction.

1. (a) The isolation stoppings made in pursuance of Regulation 100(4) to control Spontaneous heating or fire should have a minimum thickness of not less than 1 metre.

(b) The stoppings should be built with bricks in lime or cement mortar.

Locking:

2. The isolation stoppings should be well keyed into the roof, floor and sides, and for this purpose, the minimum depth of locking should be as follows :—

(i) In coal—1.0 metre (3.28 ft.).

(ii) Sand stone roof/floor—15 cm. (6").

(iii) Shale Stone roof/floor—30.4 cms. (1.0ft.).

Prevention of Leakage:

3. (a) The stoppings should be faced with sufficient thickness of lime or cement plaster to prevent leakage of air.

(b) In order to prevent breathing of air through the sides containing the stopping, the roof, floor and sides should also be kept plastered with lime or cement for a distance of at least 1 metre outbye of the stopping.

White Washing and Numbering:

4. The stoppings should be kept white washed and numbered.

B. Actively and Potentially Gassy Mines: Thickness and construction.

1. Each explosion-proof stopping should consist of a set of two brick stoppings built in cement mortar having a minimum thickness of not less than 1 metre and spaced at least 4.5 metres (15 ft.) apart. The intervening space between the two stoppings should be packed solid with incombustible materials (there should be no coal pieces or other carbonaceous matter in the packing).

Locking:

2. Both the inbye and outbye stoppings should be well keyed into the roof, floor and sides in the same manner as specified above for isolation stoppings built in non-gassy and technically gassy mines.

Prevention of Leakage:

3. (a) The outbye stoppings should be faced with sufficient thickness of lime or cement plaster to prevent leakage of air.

(b) In order to prevent breathing of air through the sides containing the outbye stoppings, the roof, floor and sides should also be kept plastered with cement for a distance of at least 1 metre outbye of the stopping.

White-washing and Numbering:

4. The stoppings should be kept washed and numbered.

Minimum Thickness is the thickness of stoppins as measured near the roof level.

Copy of Circular No. 25 of 1964 dated 29th June, 1964

SUBJECT: *Providing doors in preparatory stoppings.*

Sub-regulation (4) of Regulation 100 of Coal Mines Regulation 1957, requires that before commencing extraction of pillars by caving system in any seam or section, fire dams or stoppings are provided in all openings other than openings essential for ventilation and haulage, around the area to be extracted; and in the roads kept open for ventilation or haulage foundations for such dams or stoppings are prepared and bricks and other suitable materials kept readily available in their vicinity. Past experience in dealing with fires in depillaring area has shown that even where bricks and other suitable materials are kept available in the vicinity of preparatory stoppings, it takes long time in sealing off the affected area causing thereby avoidable difficulties. It is, therefore, recommended that every preparatory stopping around a depillaring area is fitted with steel door which can be shut off immediately in the event of an outbreak of fire. The construction of brick stopping can thereafter follow in comparatively better conditions.

Copy of circular No. 32 of 1964 dated 20th July 1964

SUBJECT: *Surface precautions against fire*

Please refer to this office Circular No. 20 dated the 16th May, 1959, wherein your special attention had been drawn to the provisions of Regulation 117 for taking precautions against occurrence of surface fires.

Prompt Detention of Surface Fires:

It has been seen that in some cases the fire had broken out on the surface long before it was detected by the officials of the mine with the result that the operations to control the fire became more difficult. Small fires which could have been dealt with quickly had developed into big fires requiring considerable time and effort.

Under Regulation 117(6) of the Coal Mines Regulations, 1957 of a competent person (sirdar and overman) is required to inspect once at least in every 7 days the top of all entrances to a mine, all opencast workings and any ground broken by extraction of coal in order to ascertain whether the precautions against surface fire had been taken and for detection of any fire that may have broken out or any indications thereof. It appears that such inspections are either not being done regularly or they are not enough. It is therefore recommended that in addition to the weekly inspection by the junior supervisory staff, the manager and other senior officials should also make surface inspections at least once every month.

Danger of Fire from Soft Coke Making:

In this connection it may also be mentioned that the practice of making soft coke in quarries or over broken ground is particularly fraught with danger and should be strictly prohibited.

Copy of Circular No. 56 of 1964 dated 9th Nov. 1964

SUBJECT : *Occurrence of fire in quarry debris.*

There have been a number of cases of fire occurring in quarry debris either due to spontaneous heating or due to preparation of soft coke or deposition of heating material or hot ashes etc. over the quarry debris. There have also been instances of such fires travelling underground through the entrance to underground working from the quarry. Needless to say, once the fire goes underground it becomes very difficult to control it, there is usually huge loss of coal and considerable expense is involved in dealing with the fire.

To reduce the chance of occurrence of fires in quarries, Regulation 117 of the Coal Mines Regulations, 1957, lays down certain precautions to be taken, but these precautions are apparently not enough for preventing a fire, should it occur in a quarry, from going into the underground working started from the quarry. It is therefore recommended that in addition to the usual precautions, a zone of at least 15 metres from the entrances to underground workings and the coal face in the quarry should be kept clear of all quarry debris, wild or harbaceous plant, and any other carbonacious material. This zone should be maintained scrupulously clean right upto the bed of the quarry.

I shall be pleased if immediate action is taken wherever required, to give effect to the above recommendation as early as possible so as to prevent the possibility of a quarry fire being transferred underground.

Copy of Circular No. 62 of 1964 dated 21st November, 1964

SUBJECT : *Provisions of preparatory stoppings for development districts underground.*

There have been some occurrence of fire in development districts of mines. These fires were caused from use of explosives. Recently there was also a case of fire in which a part of coal pillar between main intake and main return had caught fire due to spontaneous heating along a fault place crevice traversing the pillar.

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To ensure that the whole mine has not to be sealed off because of fire in a development district, it is considered advisable that besides the arrangements for fire-fighting that are required to be provided under the regulations read with this office circular No. 2 of 1960, it would be desirable to construct preparatory stoppings in the entries to one or more development district depending upon local conditions. Sufficient building materials like bricks and other suitable materials should be kept readily available in the vicinity. Doors should also be provided which are normally kept open but can immediately close the opening of preparatory stopping as a first step for cutting off air to the district(s) affected by the fire if it is decided to control the fire by isolation of the district(s).

Copy of Circular No. 66 of 1964 dated 26th November, 1964

SUBJECT : *Provision of isolation stoppings around old workings.*

With the bord and pillar system of mining practised in Indian Mines at present, there are usually old developed workings in most of the mines. Although the regulations require that such workings should be regularly inspected, kept secure and free from gas, coal dust etc. it has been seen that these workings are not maintained in a safe condition all the time. Moreover, the workings require certain quantity of air to be circulated around them to make them fit for inspection and to keep them free from gas. Again in the cases of old workings of gassy mines although it had been recommended vide this office Circular No. 48 of 1959 that the blind ends should either be connected or the air current should be conducted right up to the faces by means of brattice partitions to prevent accumulation of inflammable gas, there have been practical difficulties in the case of some mines to give effect to this recommendation.

Considering the above aspects, the question of isolating the old workings had been under consideration of this office for sometime. Certain fears have been expressed about isolation of such workings specially in the case of actively gassy mines. As a matter of fact in one or two cases gas had accumulated in large quantities after sealing off. Again in certain seams, specially Dishergarh Seam, where there are large falls of roof coal resulting in heaps of coal 1 to 1.5 metres in height, there may be the danger (if the area is not properly sealed off to completely prevent circulation of air through stoppings, pillars etc.) of spontaneous heating and fire. Then there is also the question of cost of isolation of old workings. Notwithstanding all these objections, it is considered advisable to isolate the old workings not only from safety point of view but also because of certain other important resultant advantages. Thus such a measure should result in considerable saving in the amount of ventilation, stone dust, personnel etc., required to keep the workigs in safe condition. Moreover, isolation of old workings should also generally help in conservation of coal because there would be much less deterioration of old workings standing on pillars.

It is therefore, recommended that to start with old workings may be kept sealed off by explosion proof stoppings in actively gassy mines and by 1 metre thick stoppings in technically and potentially gassy mines. In order to prevent building up of pressure of gas behind the sealed off area it will be necessary to make arrangements for bleeding of gas from the sealed off areas in actively gassy mines. Air sampling pipes should be provided for all sealed off areas (whether in actively, potentially or technically gassy mine) as already recommended in this office Circular No. 30 of 1964 to keep a check on the atmospheric condition behind the isolation stoppings.

However, where there are any practical difficulties in isolating the old workings in a gassy mine, the matter may be referred to the Chief Inspector of Mines for advice.

Copy of Circular No. 2 of 1965 dated 11th Jan. 1965

SUBJECT : *Precautions against underground Fire.*

Recently a mine had to be sealed off at the outlets after an outbreak a fire in a depillaring district of the mine. The incident focussed attention to the following points which are being brought to your attention for information and guidance :

1. The gob stink was detected by the Mining Sirdar at the end of the night shift of a rest day. It appeared that the district had not been properly inspected during the whole of the rest day and thus the stink had remained undetected for a long period. The necessity for inspection of all depillaring districts on rest days by an Overman as already advised in this office Circular No. 7 of 1960 needs no further emphasis.

2. No doors had been provided in the two preparatory stoppings. It is essential that doors of suitable design should be fitted in all the preparatory stoppings constructed in the mine so that the part of the workings affected by heating or fire can be isolated expeditiously and the whole mine has not to be sealed off at the outlets as happened in this case.

In this context attention is invited to this office Circular No. 25 of 1964 in which provision of doors in preparatory stoppings had been recommended earlier.

3. The surface fan should be provided with a reversing arrangement. In the incident mentioned above no such arragement was provided with the result that no attempt could be made to save the situation by reversing the air current.

Copy of Circular No. 17 of 1965 dated 8th April, 1965

It is well known that the ventilating pressure in our mines are generally on the low side. Even then there are instances of outbreak of fire in solid coal pillars in some seams which abound with prominent cleavage plans. Recently in one of the mines a fire broke out in a coal pillar situated between the main intake and the main return of the mine. The pillar was triangular in shape and was 7 metres thick at the place where the fire originated. The original seat of the fire was found to be 3.15 metres within the coal pillar and the fire had gradually travelled upto the main intake airway through a prominent cleavage plane.

Though such occurrence is not common but in view of the fact that more mechanical ventilators of higher capacity and pressure are likely to be installed not in the distant future it is advisable for the Industry to consider such a possibility and take precautionary measures. It is suggested that in coal seams which abound with natural prominent cleavage planes or geological disturbances, the intake and return roadways shall be as far away (say at least 2 pillars length) from each other as practicable. Where due to operational difficulty the intake and return roadways have to be maintained adjacent to each other, the pillars between them shall be of adequate larger dimension than what is provided in the Statute.

Copy of Circular No. 23 of 1965 dated 22nd April, 1965

SUBJECT : *Preparatory stoppings ground depillaring areas.*

According to sub-Regulation 4 of the Regulation 100 of Coal Mines Regulations 1957 and as per Circulars issued from this office, isolation and preparatory stoppings have to be provided prior to the commencement of extraction or reduction of pillars in a panel/district. The necessity of these stoppings has also been stressed upon all concerned a number of times through various Circulars issued from this office. It has been found, that at times the preparatory stoppings are not closed for quite a time even though the pillars adjacent to them had been extracted and the roof had caved in. This was the primary reason for outbreak of spontaneous heating recently in one of the collieries. If these prepartory stoppings are not closed within a few days of extraction of adjacent pillars and the air is allowed to breath into the goaf, the very purpose of providing isolation and preparatory stoppings is defeated.

You are therefore, advised to ensure that all the preparatory stoppings around depillaring area are closed effectively as soon as the pillar/pillars adjacent to them are extracted.

Copy of Circular No. 7 of 1966 dated 5th Feb. 1966

SUBJECT: *Layout of Board and Pillar working*

As we all know, the common method of developing a coal seam in India has been and still continues to be the Board and Pillar system of working. The dimensions of pillars and galleries are laid down in the regulations which have been formulated to ensure mainly the stability of workings at various depths.

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2. We also know that it is very desirable to form panels leaving barriers of coal between adjacent panels with minimum essential entries to each panel. The size of a panel is usually governed by the incubation period of a seam, and is sometimes also influenced by the system of mechanisation adopted. The panel system of development has many advantages. Most of the coal seams in India are usually liable to spontaneous heating and therefore, in the event of a spontaneous heating or fire in a mine it is possible to control the heating or fire and limit its extent with the isolation of the affected panel only. Development on panel system permits also provision of independent ventilation splits for each panel; requires less number of isolation stoppings to be built during depillaring operations; the number of stone dust barriers/

explosion proof stoppings to be provided is usually much less; and a panel may be easily kept isolated pending commencement of final operations with a number of attendant advantages as pointed out in this office Circular No. 66 of 1964. Thus the panel system of development is not only to be preferred from safety and conservation points of view but it is also likely to prove an economical method of working in the long run.

3. A still better method of working while opening out a seam or a part of a seam is to drive 4 or 5 headings along strike and then along dip and rise upto the mine boundary or a predetermined barrier as quickly as possible and to form panels on the retreat. In this method of working a system of more or less simultaneous development and depillaring could be conveniently arranged in the same panel or adjacent panels. Such a method of working can be planned to yield the desired output at the initial development stages and it has the added advantages of concentration of workings, very much reduced chances of spontaneous heating, better roof control, little or no weatherin or spalling of pillars, no old panels requiring inspection or isolation to keep them in safe condition etc. etc.

4.1. Although the above-mentioned principles of good development are well recognised, it is found that there continue to be many haphazard and unplanned developments. It is high time therefore, that old method of ordinary development in which all galleries are interconnected throughout in a honey combed fashion is stopped and while adopting bord and pillar system the workings are developed on panel system only, preferably in the manner indicated in the preceding paragraph. It is also advisable that a layout plan should be prepared for every scheme of new development of a seam or part of a seam. The layout plan should be sufficiently comprehensive covering the entire area of proposed development or at least the part of the area which is likely to be developed in the course of next 3 years, and take into account the existence of important surface features like railways, rivers, roads, buildings, presence of waterlogged workings or fire in the vicinity etc. In preparing the plan of development, the manner in which the final operation or depillaring would be carried out should be kept in close view to avoid any complications or wasteful mining later on.

4.2. A copy of the layout plan should be kept at the office of the mine and a copy may be sent to this office for scrutiny. If desired, this plan may be submitted for approval jointly under all the relevant regulations (e.g. Regulations 100, 104, 105, 122). Such a procedure would eliminate the necessity of submitting from time to time a number of separate applications for statutory permissions and thus ensure uninterrupted working of the mine in so far as compliance with regulations is concerned.

5. Needless to stress, it is important in the interest of proper development of workings both from safety and conservation points of view that all future workings should be laid out in a planned manner, and when bord and pillar system of work is adopted the development should be on the lines indicated above.

Copy of Circular No. 17 of 1966 dated 31st March, 1966

SUBJECT: *Installation of mechanical ventilation.*

It is no doubt necessary that when the workings of a mine become extensive, arrangements for ventilation thereof should be made with a mechanical ventilator installed at the surface. As you are aware, Regional Inspectors of Mines are empowered under sub-regulation (4) of regulation 131 of the Coal Mines Regulations, 1957, to require the provision of a mechanical ventilator in any mine where the ventilation is considered to be inadequate. This power is being exercised by the Regional Inspctors as and when necessary. In this connection it has now been decided that if the underground workings of a non-gassy mine extend for a distance of 60 metres or more in any direction from the entrances to the mine, each such mine would be directed by the Regional Inspectors to ventilate the workings by a surface mechanical ventilator, unless otherwise exempted by the Chief Inspector of Mines.

If in a mine there are goaves which are not sealed off or the seals are not effective due to poor construction of stoppings, there is every possibility of a fire breaking out in the goaves after the installation of a mechanical ventilator. All such mines should therefore ensure that :—

(1) All old goaves are kept effectively sealed off and if necessary, the existing seals should be properly repaired or strengthened.

(2) Test sampling pipes are fitted in the stoppings at the return and intake ends of the goaves, and regular air samples drawn from them before the installation of a mechanical ventilator and regularly thereafter for a period of at least six months. If the analysis results of the samples show at any time symptoms of heating in the sealed off area the matter should be reported immediately to the Regional Inspector of Mines concerned. In this respect attention is also invited to Circular Nos. 15 of 1961 and 30 of 1964 issued by this office.

Copy of Circular No. 34 of 1966 dated 26th May, 1966

SUBJECT : *Precautions against occurrence of fire in quarry debris.*

Your special attention is invited to this office Circular No. 56 of 1964 wherein you were advised that, 'in addition to the usual precautions against occurrence of spontaneous heating in quarries, a zone of at least 15 metres from the entrances to underground workings and the coal face in the quarry should be kept clean of all quarry debris, wild or herbaceous plants and any other carbonacious material. This zone should be maintained scrupulously clean right upto the head of the quarry.

It is regrettable that recently there have been fresh cases of fires in quarries where the recommended precautions had not been taken. I would therefore advise all mine managements having open cast workings to see that the above mentioned protective works are completed latest by 30th June,

1966. A report of compliance in this regard should be forwarded to the Deputy Chief Inspector/Regional Inspector of Mines concerned.

Copy of Circular No. 55 of 1966 dated 12th August, 1966

SUBJECT : *Precautions to be taken when using flame-cutting apparatus oxy-acetylone welding apparatus or electric welding apparatus in shafts.*

Of late there have been some incidents of fire occurring in shafts where welding apparatus had been used in repairing jobs. Sometimes ago an explosion had occurred in a shaft when the sparks from a welding apparatus which was being used at the pit top fell down the shaft of an actively gassy mine. Recently an incident occurred at another mine where a new headgear was being installed and holes were being drilled in the headgear with gas-cutting equipment. Hot particles of the cut material fell on the wooden platform that had been placed at the decking level to cover the shaft, and also at the second platform that had been provided at the ground level of the shaft. Both the platforms caught fire and were completely burnt out. Fortunately the workers were withdrawn from underground well in time and there was no further untoward happening.

2. These incidents illustrate the need for extreme care that should be exercised whenever any gas or electric welding apparatus has to be used on the head-gear or in a shaft. In all such cases, the following precautions should be taken:

(1) Before cutting or welding operations commence, and whilst such operations are in progress, a responsible person (who is a qualified engineer or holds a manager's certificate) duly authorised by the manager in writing, shall be placed in charge of the entire work. He shall patrol in or about any structure or building close to the cutting or welding operations, where risk of fire may arise consequent upon such work.

(2) All inflammable material of a portable nature shall be removed from the site of operations and greese, fat and coal dust shall be cleared away.

(3) Suitable protection shall be provided immediately under the work place. Such a protection shall be made from non-inflammable materials so that sparks or particles flying out during welding or flame cutting operations do not past down the shaft:

Provided that wooden platforms may be used as protective shield only when they are protected by sheet metal covered with wet sand, and the protection shall be so arranged that it does not get damaged or burnt by the falling particles.

(4) All inflammable material remaining in the vicinity shall be thoroughly wetted with water or completely covered with sand or stone dust.

(5) As far as practicable, unless the shaft is naturally wet, it shall be wetted with water before the work is started and after it is finished.

(6) At least two foam fire extinguishers shall be provided and held in readiness for immediate use, if necessary. Where cutting or welding takes place in close proximity to any electrical apparatus the latter shall be securely screened and sufficient number of CO_2 extinguishers shall be kept readily available.

(7) As soon as cutting or welding operations are completed, the responsible official (appointed by the manager as mentioned under sub-paragraph (1) above shall examine the place, and unless we can satisfy himself that the place is safe, further inspections shall be made from time to time during the next four hours, and if necessary thereafter, until the responsible official has satisfied himself that the place is safe and has so reported to the manager. The parts of the shaft where such special inspections should be made shall include shaft bottom and all insets below where the cutting or welding operations have taken place. During these inspections, all fire precautions including those mentioned in the foregoing sub-paragraphs shall be kept in commission.

(8) Only the minimum number of persons shall be allowed to remain underground when any cutting or welding operation is in progress in any shaft or headgear and the persons withdrawn from the mine before commencement of such operations shall not be re-admitted into the mine except with prior permission of the manager.

(9) A written record of every occasion when the cutting or welding apparatus was used in the shaft or head-gear, the circumstances when it was used, the results of examination for fire, and the name and designation of the person who supervised the operation, shall be maintained in a bound paged book.

3. The aforesaid precautions are given here for general guidance of the managers and all others concerned. In case of a mine where the provisions of regulation 144 apply it is recommended that a flame or electric welding or repairing apparatus should not be used in a headgear unless prior permission in writing has been obtained from the concerned Regional Inspector of Mines and subject to such additional precautions as he may specify.

(Note :—In case any such apparatus is used in shafts, the provisions of Regulation 118(2) shall be complied with).

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Copy of Circular No. 2 of 1967 dated the 7th Jan. 1967

SUBJECT : *Stacking of Coal underground Precautions against danger from fire underground.*

Your attention is invited to regulation 118(4) (a) which requires that "no coal, shale or other carbonaceous material shall be left or stacked below-ground if it is likely to cause spontaneous combustion."

2.1. It has been brought to my notice that in some mines stacks of coal and shale are still being left underground in the blind galleries or in the roadways branching off the travelling and haulage roadways, and sometimes also in the discontinued workings (which are not sealed off), without taking any precautionary measures as given in Circular No. 7 of 1960.

2.2. Needless to stress that every such stack of coal/shale is a potential source of spontaneous heating and fire under favourable conditions. Therefore no such stacks should be left underground anywhere and all accessible places should be scrupulously kept clean and adequately stone dusted.

2.3. Where it is not practicable to remove the fallen coal, the matter should be brought to the attention of Regional Inspector of Mines, and the method of dealing with the situation may be decided in consultation with him. In this connection it may be mentioned that sealing of fallen coal by slushing or blanketing of sand as earlier recommended in Circular No. 7 of 1960 is not likely to prove always successful in the light of experience that has been since gained in dealing with fires.

3. I shall be pleased if suitable precautionary measures are taken to prevent risk of fire from this potential source of danger underground.

Copy of Circular No. 19 of 1967 dated the 11th April, 1967

SUBJECT : *Emergency Door Seal.*

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Please refer to this office Circular No. 25 of 1964 wherein it had been recommended that every preparatory stopping around a depillaring area should be fitted with steel door which can be shut off immediately in the event of symptoms of spontaneous heating or outbreak of fire.

Another effective manner of quickly isolating an area is by providing an emergency door seal consisting of reinforced cement slabs which can be readily pushed home within a steel frame work previously built in a preparatory stopping. The constructional details of one such type of seal, which has been successfully adopted in one of the mines in Ranigunge Coalfield, are given in the note enclosed with this circular for guidance. As would be noted, it does not take more than

10 minutes to complete this seal by one person. The dimensions of the seal may be altered to suit local requirements. When there is a rail track in the gallery containing preparatory stopping, the part of the rail track in the opening of the preparatory stopping should be so fitted as to be readily removable. If the gallery is very wide the emergency door seal may preferably be made of two parts.

Copy of Circular No. 59 of 1967 dated 9th Oct. 1967

SUBJECT : *Model standing orders for immediate action to be taken on occurrence of underground fire.*

Please refer to Circular No. 2 of 1960—regarding fire-fighting equipment and organisation at mines.

Under para 6 of the above mentioned circular, the manager of every mine should draw up standing orders laying down the procedure to be adopted for giving warning of fires, for withdrawal of personnel from the mine and for the conduct of fire-fighting operations. The Standing orders are to be sent to this Directorate for approval.

It has been seen that the Standing Orders framed by the managers of different mines had to be modified considerably. Model standing, orders have therefore been prepared and a copy of the same is given in the Appendix for enforcement at your mine. If the Model Standing Orders need any modification to suit local conditions the same may be amended with prior approval of this Directorate.

ANNEXURE-II

History of mine fires

A. JAHARIA—MUGMA—KATRAS COALFIELD

sl. no.	colliery	seams affected	origin and cause of fire	measures taken to control the fire	present position
(1)	(2)	(3)	(4)	(5)	(6)
	Jharia Fire Area				
1	New Khas Jharia	XI/XII	Originated in 1931 in Khas Jharia Colliery due to spontaneous combustion in prematurely collapsed workings. Then spread over to the adjoining New-Khas Jharia, Suratand and Phularibad colly.	Extensive surface blanketing with sand and earth since 1940. Underground packing a'so done.	The fire has been controlled, more or less all involved mines abandoned since thirtees, maintenance of blanketing being continued.
2	Khas Jharia	XI/XII			
3	Sonalibed	XII/XIV			
4	Pularibad	XIII/XIV			
5	Nilrui Patra	XIII(Seal)			

(1)	(2)	(3)	(4)	(5)	(6)
	Surtand Fire Area				
6	New Suratand	XV,XIV&XI	Originated in May'47 near No. 7 pit due to spontaneous heating in XV seam in the New Suratand Colliery. The heating was preceded by premature collapse of bad and unstable workings.	Nos. XV, XIV & XIII have been affected by this fire and fire spread over to Kalithan Suratand Colliery. Blanketing operations with sand, building of dams in connecting galleries between XIV and XIII.	Fire in New Suratand under control but that in Kalithan extended to adjoining mine along Eastern Barrier. Further blanketing continued. Both collieries are abandoned.
7	Kalithan Suratna	(Sel)			
	Bhowra Colliery				
8	6 & 9 incl. area .	XIV	(a) Fire broke out in XIV seam in 1929 due to spontaneous heating in goaf.	(a) Openings sealed off. dip portion kept under water.	(a)-(b)-In 1961-62 the situation aggravated due to old fire joining with 3 incl. fire as a result of eating away of the barrier; fire active and burning along the outcrop of the XIV seam. Further blanketing has been proposed.
9	3A Incl. area	XIV/XIII/XII	(b) Fire broke out in XIV seam in 1958 due to spontaneous heating in crushed area premature collapse.	(b) Extensive measures including fire stoppings, dams, stowing, filling of shaft and blanketing. Fire isolated by a water barrier.	

10	10A Incl. area	XIV/XII(Sel.)	(c) Fire broke out in XIII seam in 1959 in a depillaring dist. due to spontaneous heating and also affected a portion of XIV seam.	(c) The progress of the fire has been checked firstly by hyd. stowing in outbye workings and secondly by excavating a trench in the XIII seam under assistance from Board. Blanketing and removal of qry. debris is also resorted wherever necessary.	(c) The fire has been kept isolated in a limited area.
11	PATHARDIH	XI/XII (Gr. II)	1952, due to heating in crushed pillars.	Brought under complete control by drowing.	Dewatered in 1962 and successfully reopened.
12	PURE DWINA-BAND	VII (III Gr.)	1954, due to heating in crushed coal stooks in 4th section of VII seam.	Trenching and removal of heated debris.	Fire completely controlled.
13	MADE-UBAND .	XI/XII (Gr. I)	1956, fire due to spont. heating in rise side old goaf in XI/XII	Dip side workings drowned. It was not possible to raise water level upto fire area, so fire allowed to burn out in rise fringe.	Rise side fringe is still burning.

(1)	(2)	(3)	(4)	(5)	(6)
14	STANDARD (Behehir fire area)	XV/XIVA/ XIV (Sel.)	Originated in 1927, due to spontaneous heating in XV seam goaf and then migrated to underlying XIVA & XIV.	Blanketing with sand, surface levelling and filling of cracks and fissures.	Fire still active in goaf area, filling of abandoned shaft undertaken, colliery abandoned.
	Pure Jharia Fire Area				
15	Pure Jharia	X (Gr. II)	Originated in 1955 in old goaf of X Seam at Pure Jharia due to spontaneous heating.	(a) Controlled flooding to protect the Rly. line. (b) Sand flushing through boreholes to form an incombustible barrier against the Rly. line. (c) Sand blanketing along quarry edge of X Seam.	New Pure Jharia and pure Jharia are now abandoned. Seams below are virgin under water. Fire was very active within the area but its spread has been brought under control.
16	New Pure Jharia				
17	Dobari (R.N. Bagchi)				

				(d) Trenching—a big isolation trench towards K.P. Dobari R. N. Bagchi's Dobari.	
	Ekra Khas Fire Area				
18	South of D. B. Road.	XIV/XIII (Sel. B)	Fire on south originated in the year 1928 due to spontaneous heating.	XIV/XIII seam abandoned dip side drowned, some blanketing operations also done.	Fire has affected only the XIV & XIII seams and the fire occasionally becomes active when blanketing in that part is quickly done.
19	North of D. B. Road.	XIV/XIII (Sel. B)	Fire originated in the year 1957 in quarry debris and in course of time affected XI/XII seam also.	Initially isolation trench was being excavated around the affected area. Later drowning of the underground working were resorted to, simultaneously with blanketing along the Ekra Jorebund for the protection of the jore.	The fire has engulfed the entire XIV/XIII/XII/XI/seam workings of Ekra Khas Colliery leaving X Seam under water. Maintenance work is being done by the Board departmentally.

(1)	(2)	(3)	(4)	(5)	(6)
	Jobta khas Fire Area				
20	Jogta	XIV/XV/XII (Sel. B)	Fire originated in 1929 due to spontaneous heating in XV seam. Fire travelled to XIV seam at a later date. Also there appeared an independent fire in XIV seam.	Various measures during different periods such as U/G packing, stoppings, isolation trenches, surface blanketing and sand flushing were taken to control the fire. Also sand flushing through boreholes to stabilise the workings beneath the jore and sand flushing through boreholes to form an incombustible barrier against Sijua Railway Station land were done	The Sendra Fire is now limited and drowning of seams is likely to save some coal which will be still available. The fire can be taken to be effectively controlled.

21	Sendra	XIII/XI (Sel. B)	Fire originated in the year 1930 in XIV seam due to spontaneous heating.	Drowning of XI and XIII seams of Sendra Colliery and surface blanketing with waterpooling resorted to.	Jogta fire still more active in Western part and progressing on dipside which are drowned. In the rise side the fire is still perceptible in XI/XII seams. In both cases full-scale maintenance work is being carried on by Board departmentally.
22	Bararee . .	XV(Sel.A)	Fire broke out many years ago due to spontaneous heating in goaf and depillaring area.	U/G stoppings, surface blanketing with quarry overburden and sand. Creation of a sand barrier continuing.	Fire is still active but kept under control. Colliery is working.
23	Bhulanbararee .	XIV/XV (Sel. A)	Over 30 years before, broke out due to spontaneous heating.	U/G stoppings and sand barrier, surface blanketing with sand, shaft sealing of No. 1 Pit.	Fire under check. Colliery is working and maintaining blanketing.

(1)	(2)	(3)	(4)	(5)	(6)
24	Central Kirkend	XIV/XII (Sel.)	Fire originated in early forties due to spontaneous heating.	U/G packing with sand and localised blanketing with sand.	The fire has affected entire XIV and XIII seam workings and is active in the Western part.
	Angarpath ra Fire Area				
25	Khas Angarpathra	XI/XII (Gr.I)	Fire originated in rise workings of the colliery during 1951 possibly due to spontaneous heating.	Entire affected area has been drowned by controlled flooding from Kumari Jore.	Fire on dip side likely to have been quenched. On rise side fire is still perceptible in XI/XII seams. It might be possible to dewater the area and recover the seams.
26	National Angarpathra.				
27	East Angarpathra				
	Jeenagora Fire Area				
28	Kalithan Jeengora	X (Gr. II)	Fire originated and detected in X seam of Kalithan Jeenagora in 1944. Fire possibly occurred due to a combination of causes spontaneous heating and Bontulsi Conflagration.	Sand blanketing, U/G stopping in Jeenagora and maintenance of blanketing.	Active fire appears to have been brought under control. Same seam in other areas of Kalithan Jeenagora and lower seams in Central Jeenagora are now working.
29	Central Jeenagora				

30	Sendra Bansjora	XI (Sel. B)	1950. Fire in quarry debris of XI seam due to 'Bontulsi' later threatened XIII/XI.	Digging, trenching and removal of heated material with water spraying.	Fire effectively controlled and extinguished.
31	Central Bansjora	XII (III B)	1950 Fire originated by 'Bountulsi' conflagration which in turn set fire to bush coal in quarry.	Isolation trench.	Fire checked and dugout
	Dhariajoba Fire Area				
32	Dhariajoba	XI/XII (Gr. II)	The fire broke out in the old goaf of XI/XII seams in 1959, from illicit distilation, involving West Godhur and Bansdeopur.	Surface blanketing with earth sand flushing through boreholes to protect Kusunda Rly. yard and U/G packing in adjacent Bansdeopur colliery. Isolation trench and water dams in West Godhur property.	Dhariajoba is abandoned but West Godhur is working. Fire is fully checked.
33	next Godhar				

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(1)	(2)	(3)	(4)	(5)	(6)
34	South Tisra .	XI (Gr. II)	Fire caused by illicit distillation in abandoned old incline (1961 spread to goaves of XI and to XII seams in 1963.	Controlled flooding by introducing water from Chatkarijore. The fire has affected the old goaves and quarry debris of XI/XII seams of neighbouring Bengal Jharia colliery.	Fire is spreading towards A. G. Tisra since the water level is unable to quench down. No extractable coal being affected presently.
35	Ganeshpur	XIII (Gr. III)	Fire originated in 1946 due to illicit distillation, spread into mine and ultimately travelled to Khas Ganeshpur XI/XII seams through broken strata. The fire also threatened Ashakuti Phularitand.	Fire kept sealed off by U/G, stopping and hydraulic stowing forming an artificial barrier.	The fire though active has been brought under control. Khas Ganeshpur abandoned but Ganeshpur lower seams are working.
35	Upper Mandra .	VII (IIIB)	1949. Heating in quarry debris.	Quenching with water and trenching.	Fire completely checked.

37	Bhuggatdih	XI/XII/XIII/ XIV	1950. Heating in quarry debris.	Surface blanketing, sealing of shafts, building stoppings U/G, making trench upto floor of XI seam and sand barrier in adjacent mines.	Fire contained within the limits of Ena/ Bhuggatdih colliery. X seam being worked now.
38	Lakurka		1963. Heating in quarry debris and burden of XIV seam quarry. Fire spread to goaf of XIV seam.	Trench cutting, pumping water to fire area since fire jumped the trench which was back-filled. Creation of terraced fields U/G stopping, dams etc.	Fire under check, work was first started by colliery. Later on taken up by Board due to lackdiasical attitude of the colliery. All U/G work done by colliery itself. Surface maintenance still being looked after by Board.
39	Lower Upper Jharia.	XII	1964. Heating in quarry debris of XIII seam quarry.	Excavation and removal of heated debris. Creation of water trench against coal and construc-	Fire was under control till recently when fire crossed the trench during dry season and

(1)	(2)	(3)	(4)	(5)	(6)
				tion of dams for pumping water	affected XII seam workings (1967). Further advance checked by construction of dams and flooding. Fire now under check.
40	East Katras	IX	1951. Fire in heap of quarry debris and 'Bhusa' coal.	Digging out.	Digging was successful.
41	New Pandedih	XII/XIII	1951. -Fire occurred at out-crop of 7/8 seam due to dumping of overburden.	Digging out and quenching.	Digging was successful.
42	Ganhoodih.	X	1952. Fire in old debris of X seam adjacent to quarry debris. Again burning debris were kept quite close to any face which caught fire.	Trench cutting and water spraying.	Fire controlled. Work done jointly by Company and Board.
43	Bengal Jharia	X	1956. Quarry debris heating.	Trench cutting and flooding.	U/G working under fire. Fire, however progressing towards A. G. Tisra (North) along quarry edges.

44	Kustore	XV	1952. Heating in quarry debris.	Scooping heated material, french cutting and blanketing.	Fire controlled effectively.
45	Madhuband	XII	1966. Heating in collapsed outcrop.	No action since the fire does not affect anything.	Burning.
46	West Phularitand	VII	1966. Quarry spontaneous heating.	Removal of debris and water spraying.	Work completed.
47	Mondal's Kenduadih.	X	1966. Quarry spontaneous heating.	Isolation trench and drowning.	Work going on.
48	Dumra Khas	VII	1966. Quarry spontaneous heating.	Digging out and water spraying.	Successfully dug out.
49	Diamond Angarpathra.	V	1967. Quarry spontaneous heating.	Isolation trench.	Fire controlled.
50	New Angarpathra	IX	1967. Heating of old slack heap.	Digging out and water spraying.	Progressing.
51	Murulidih	Mahudu	1967. Fire occurred due to spontaneous heating in debris heap laying close to fan drift and coal pillars.	Removal of heating material and quarrying out of coal pillars.	Successfully completed.

(1)	(2)	(3)	(4)	(5)	(6)
52	East Salanpur .	X	1965. Quarry debris. Spontaneous heating.	Digging out cutting of trench.	Successfully completed.
53	Tundoo Khas .	X	1965. Quary debris. Spontaueous heating.	Trenching and watering.	Successfully completed.
54	Pure Benedih .	VIII	1965. In goaf due to Bontulsi conflagration.	Water jets on heated material digging out later on blanketing of certain parts.	Fire controlled.
55	Ashakuty .	X	1966. Quarry debris. Spontaneous heating.	Digging quenching and Trench cutting.	Work completed and fire controlled.
56	Kessugarh.	XI	1966. Quarry debris. Spontaneous heating.	Drgging quenching and Trench cutting.	Working completed and fire controlled.
57	Bhalgora		1966. Fire occurred in the old boiler ash heap and the goaf of XIV seam due to surface rejection.	Removal of heated material ana earth filling of subsidences.	Work completed and fire controlled.

58	Bhaggardih	XV/XIV	1959. XV seam quarry debris heating.	Isolation trench.	XV seam work complete. XIV going on.
59	Busseriya	XIII/XIV/X/XI/XII	(a) Fire occurred in 1966 in XIII/XIV quarry debris Spontaneous heating. It later spread to X/XI/XII seams in 1967.	Removal of heated material with water jets.	Work going on.
			(b) 1967-X seam quarry either due to spontaneous heating of debris or fire in 'Bontulsi'.	Digging with help of water jets.	
60	Industry/West Ena	XI/XII	1966. In XI/XII seam quarry heaps, due to illicit distillation. Boiler ash heap also flared up.	Circular isolation trench around fire.	Work completed and fire controlled.
61	Ghanoodih	V/VI/VII	1966. Quarry debirs fire-'Bontulsi' conflagration.	Digging out heated material.	Work completed and fire controlled.

(1)	(2)	(3)	(4)	(5)	(6)
62	R. N. Bagchi's Dobari Colly.		(a) 1967. One new fire occurred in a boiler ash heap on Southern Side of Board's trench due to spontaneous heating.	Quenching and digging out.	Work completed and fire controlled.
			(b) 1967. Another new fire occurred in old quarry debris very close to Board's trench due to spontaneous heating.	Do	Partially complete.
63	NCDC's Sudamdih	IX/X	Originated in July '66 in the old quarry since long abandoned in the Sutikdih section—possibly due to spontaneous heating or due to illicit distillation.	Blanketing of area has been suggested. The dip workings are under water; therefore the fire is not causing serious threat.	Action on a limited scale going on.

64	Bengal Jharia .	X	August '66, fire in depot, rejections near the jeenagora railway siding—due to spontaneous heating.	Isolation trenching.	Under control
65	West Gopalichuck	XVI	June' 66 Originated in old quarry debris of XVI seam, most probably due to spontaneous heating but might as well be due to illicit distillation. Fire also affected some coal stooks left on rise side in XVI seam.	Blanketing the quarry edges and goaf area by bull-dozer.	Appears to be under control.
66	North Kujama .	XI/XII	Old quarry debris—spontaneous heating in 1967.	Entire affected portion is being dug out.	Under control.
67	Kapasara . .	Kalimati	1966. Fire noticed in coal stock of bottom section workings—Coal face (quarry) covered with debris—spontaneous heat-	Construction of fire stoppings, cleaning debris from quarry. Building water dam, drawning quarry edge by pumping.	Fire still active, but under control.

(1)	(2)	(3)	(4)	(5)	(6)
			ing in slack coal left in quarry bed and buried with quarry debris. Crushing of stook also contributed.		
68	North Kessargarh		1959. Old fire in VII seam quarry overburden.	Trenching	Under control
69	North Brindabanpur.	Brindabanpur	1965. Fire in quarry debris due to spontaneous heating/ 'Bontulsi'.	Flooding of mine through surface jore.	Spread of fire prevented by flooding, rise side still burning. Further progress towards D.B Road of rise side burning strip being prevented by cutting a trench. Work being done by Board.
70	Tundoo Kas Majhli-Tand	X	1965. Quarry debris spontaneous heating	Isolation trench cutting.	Trench complete and fire under control.

Kari—Jore Fire Area

71	Kusunda Nydi		Fire broke out prior to 1931 due to hot coke ash negligently thrown into the goaf of XII seam in K.M. Selected Kusunda Colliery.	Extensive surface blanketing with sand, levelling of undulations and filling up of cracks with earth and flushing hydraulically with 'mutti' and sand through boreholes along side Kustore barrier.	Fire is now under control though activity of fire is concentrated mostly in Central Zone of above fire area.
72	Pure Kustore				
73	Alkusa South	XI			
74	Selected Kusunda	XII			
75	Anil Kusunda	XIII			
76	East Kusunda	XIV			
77	New Kusunda	Gr. I			
78	Kusunda				
79	South Govindpur	XI	Fire originated in 1954 in boiler ash heap.	Trench cutting and quenching heated debris.	Fire still active but under control. Fire has broken out at this colliery on four occasions in last 10 years for the same reason.
80	Do.	..	Fresh fire in 1964 in separate area.	Trench cutting.	Controlled but maintenance of trench poor.

(1)	(2)	(3)	(4)	(5)	(6)
81	Pure Joyrampur	XIIIA/XIIIB XIII	1950. Fire originated in heap of boiler ash heap near pit, also overlapping ground broken by depillaring.	Quenching digging out.	Fire controlled.
82	Khas Edgar Coor	Kalimati	1954. Fire in outcrop edge in Kalimati seam due to making of soft coke right on the quarry edge.	Trenching and filling it with water; removing all coal from barrier.	Under control.
83	West Mudidih	X	1957. Fire in rejection heap of coal depot due to deposit of hot rejections from soft coke.	Removal of heated material and quenching with water.	Under control.
84	Pure Badjna.	Badjna	1954. Fire in outcrop coal due to dumping of hot ash.	Flooding	Controlled.

सत्यमेव जयते

85	Central Kujama	..	Fire in ash heap, detected in May, 1966.	Trench cutting to isolate affected area.	Under control.
86	North Damuda .	X/XII	Fire occurred in boiler ash heap partly on goaf (1966)	U/G stoppings around goaf and digging out of heated material with water jets.	Continuing though major work completed. No danger apprehended.
87	Model Dharmaband.	IX	Fire occurred in boiler ash heap and soft coke 'Bhatta' (1966).	Trench cutting and spraying water.	Work completed and fire controlled.
88	Pure Salanpur	..	Due to Soft Coke 'Bhatta' on outcrop coal at barrier of Pure Salanpur and Salanpur Collieries (1965)	To clean ashes and carbonaceous material from the outcrop which is in river bed.	Work completed and fire controlled.
89	Nichitpur .	IX	1965. Fire in quarry debris due to heated ash thrown over it —debris spreading over broken goaf.	Spraying of water, cleaning of vegetation etc. (smallfire)	do.
90	Jealgora Govindpur	..	Fire in boiler ash heaps which were spread over goaf (1964).	Digging out and spreading out on solid ground.	do.

(1)	(2)	(3)	(4)	(5)	(6)
	Bhalgora Colliery Area	**XVA. XV & XIV**			
91	Old Standard colly.		1951-52. Fire originated in the old goaves of XV seam in adjoining standard colliery due to spontaneous heating which penetrated through the barrier.	Work of trench cutting was undertaken by the colliery but left incomplete. Pits have also been filled up. Stopping made and sand blanketing also done.	Fire is active, particularly alongside the common barrier with standard colliery (abandoned) though Bhalgora is still working lower seams.
92	Khas Jharia colly.				
93	Bagdigi	XVA/XV. XIV	Bararee colliery fire crossed to this Colliery's XV seam in 1928 and has affected XVA & XIV seams also.	Blanketing with sand, sand flushing through bore-holes along the Railway line.	Fire under control. Sand blanketing maintained by colliery.
94	Industry/West Ena	X/XI/XII	1963. Fire from XI/XII seem goaf of Ena Section punctured through barrier in XI/XII seam goaf.	Blanketing with earth, widening of galleries for formation of sand barrier.	Fire though active is under control.

95	Khas Ganeshpur .	XI/XII	1951. Fire from Ganeshpur penetrated into goaves of XI/XII seams of khas Ganeshpur.	Stoppings, hydraulic sand flusing, crushed material stowing.	Under Control.
96	Khas Joyrampur .	XIII/XIIIA XIIIB	Fire detected in May '65 in XIIIB seam goaf of Pure Lower Joyrampur Section. The fire appears to have travelled from a boiler ash heap fire which gradually creeped into the outcrop coal and goaf of XIIIB seam unnoticed. In spite of blanketing etc. fire in XIIIB seam travelled down to XIIIA in September 1966 and then to XIII seam in May 67.	1. Large scale blanketing of XIIIB seam goaf. 2. Sealing of old shaft leading to XIIIA seam. 3. Blanketing a strip of 20 m. from the edge of XIIIA outcrop.	Fire is still active but its progress to the Khas joyrampur section has been checked.

B. RANIGANJ COALFIELD

(1)	(2)	(3)	(4)	(5)	(6)
1	Singaron . .	Toposi (II)	1942-43. Spontaneous heating in collapsed old workings	Mine drowned during Monsoon.	Mine is abandoned and the workings are flooded.
2	Madhujore .	Upper Kajora (Sel. B)	1956. Spontaneous heating in depillaring areas.	Mine flooded and then sealed off.	The affected areas are still flooded and there is no indication of fire now.
3	Khas Sitalpur .	Jambad (Sel. B)	April'58. Spontaneous heating in crushed area.	Sealed off completely	Fire is under control.
4	Parbelia . .	Disergarh (Sel. A)	1960. Spontaneous heating after large fall in rise area.	Shaft sealed and then drowned. Later on recovered and affected area stowed.	No more indication of fire.
5	Victoria . .	Laikdih (Sel. A)	1960-61. Spontaneous heating in old workings.	Stowed hydraulically Contiguous working also stabilised to prevent further falls.	Fire is completely isolated.
6	North Adjoy Jambad.	Jambad (Sel. B)	1960. Spontaneous heating after collapse of a wide area.	Under ground fire was immediately isolated by stoppings and then workings flooded.	Fire under control but not extinguished.

7	Pure Jambad	Jambad (Gr. I)	1955. Spontaneous heating in old workings of Jambad seam.	Whole area was sealed off.	Fire is isolated.
8	Madanapur	Madanpur (II)	1963. In a badly worked area where pillars were split, crushing occurred there followed by fire.	Pits were sealed off and then wrokings flooded during consecutive monsoons.	Workings still main flooded.
9	Dishergarh	Dishergarh (Sel. A.)	Before 1941. Spontaneous heating in goaf.	Blanketing was done by the Colliery.	Fire is still active and visible through subsidences. The mine is not working at present. Sanctoria and Hatrol seams are also affected.
10	East Jamehari	Nega-Jemehari (I).	About 1955. Spontaneous heating in goaf.	Fire was sealed underground and surface subsidences blanketed.	Though completely sealed off fire is still active and visible sometimes in goaf cracks. Now connected to Nimcha fire.
11	Banksimulla	Koithi & Poniati (Sel. A).	1958. Spontaneous heating in old goaf.	Pits were sealed off	Fire is isolated.

(1)	(2)	(3)	(4)	(5)	(6)
12	Sitaldasji Selected	Nega Jamehari (Gr. II)	1962. Spontaneous heating in goaf.	The area was flooded & isolated; Subsidences were blanketed.	Fire is controlled.
13	Searsole	Egara Seam (I)	Nov. 63. Spontaneous heating in old goaf.	The area was isolated by stoppings.	Fire is controlled.
14	East Satgram	Satgram (Sel. B).	1963. Spontaneous heating in sealed goaf.	The fire was sealed off.	Fire is controlled.
15	Selected searsole	Egara Seam (I)	1963. Spontaneous heating in depillaring panel.	Area was isolated.	Fire is controlled.
16	Nega Jamehari khas.	Nega Jamehari (I)	1963. Spontaneous heating in depillaring panel.	Area was isolated and subsidences blanketed.	Fire is progressing further blanketing and flushing of sand by boreholes is proposed. Affected Rail line already diverted.
17	North Chora	Dobrana (II)	1964. Spontaneous heating in depillaring panel.	U/G isolation and packing. Filling of surface crackes.	Goaf is still on fire but under control.

18	Lachipur . .	U. Kajora(I)	1964. Spontaneous heating in pillars.	Water and cement injection in pillars.	Extinguished.
19	S. S. Debi's Jambad.	Jambad (I)	1965. Spontaneous heating in goaf.	Plugging the shaft and filling it up. Blanketing of surface.	Work completed. Fire dormant.
20	Banksimulla 7 & 8 Pits.	Poniati (Sel.)	1965. Spontaneous heating in goaf.	Sealed off	Fire controlled.
21	Adjoy II . .	Poniati (Sel.)	1965. Spontaneous heating in goaf.	Mine entrances sealed off.	Fire controlled.
22	Babisole . .	Sanctoria	1967. Spontaneous heating in goaf.	Panel sealed off.	Fire controlled.
23	Jaipuria Kajora .	Kajora	1966. Spontaneous heating in depillaring area.	Panel was sealed off.	Fire under control. Temperature reading with test pipes being taken regularly.
24	Nimcha . .	Nega Jamihari	1966. Spontaneous heating in depillaring area.	Panel was immediately sealed off.	Fire under control.
25	Kumardi .	Jambad	1966. Spontaneous heating U/G.	Panel was immediately sealed off.	Fire under control.

सत्यमेव जयते

(1)	(2)	(3)	(4)	(5)	(6)
26	East Nimcha .	Nega Jamihari.	1965. Spontaneous heating in shaft pillar itself which caused blazing fire course finally traced to high water gauge of mechanical ventilator.	Spraying of water and sand jets.	Fire extinguished.
27	Nimcha . .	Nimcha (Sel. B).	Long before 1952. Fire migrated from old Bengal Coal Co.s neighbouring mine where it originated due to spontaneous heating.	In the past blanketing and flooding 7 were attempted.	Signs of fire still visible. Whole mine south of Rly. line is still affected.
28	Namehari Khas .	Nega Jemihari (I)	Mine was abandoned in 1926. Probably the fire migrated from Nimcha fire area.	Some blanketing was done to prevent its spread to Jotimootuk siding. Flooding was also attempted and siding was diverted.	Signs of fire still visible on surface. Coal Board is blanketing.
29	Ramnagore .	Ramnagore Laikdih (Sel.)	Old isolated fire jumped out in 1964.	Isolation of pillars by stoppings.	Successfully isolated again.

30	Porriarp	Kasta (I)	1962. Fire in quarry edge due to burning of 'Bontulsi' but cause not known definitely.	Fire promptly dealt with and quenched.	
31	New Damajoria	Salanpur 'A'	1966. Fire in old quarry debris. Likely reason spontaneous heating or 'Bontulsi' conflagration.	Old quarry allowed to burn itself out. Existing quarry and present workings, protected by dams, trenching and flooding of dip side.	Old quarry fire stil burning.
32	Salanpur 'A' colliery.	Salanpur 'A'	1967. Origin in quarry debris. Exact cause not known but fire presumbly due to spontaneous heating.	Flooding.	Fire now burning at quarry edge but adjoining mines saved due to flooding.
33	Muslia	Ghusick (Sel.)	1958. Brattice fire leading to small gas explosion.	Mine flooded and pits sealed off.	Working are flooded.
34	Chinakuri	Disargarh (Sel.)	1962. Fire precceding an ignition.	Mine flooded and pits sealed off.	Recovered completly.
35	Poniati . .	Poniati	Cause not known	Dip workings are drowend.	Fire is active at times. Small portion of outcrop of Poniati workings are on fire.

(1)	(2)	(3)	(4)	(5)	(6)
C. OUTLYING COALFIELDS					
(a) Talcher Coalfield					
1	Talcher	Talcher Main (Sel.)	1963. Spontaneous heating in stowed dspillaring panel.	Workings were sealed and allowed to be drowned.	The eastern side workings are sealed and still flooded.
2	Handidue	do	1963. Fire in coal due to cable burst.	Pits were sealed and workings flooded.	Pits are still sealed.
(b) Madhya Pradesh Coalfields.					
1	Kurasia . .	I. II & III (Gr. I).	1963. Spontaneous heating in stacked quarry coal. Fire migrated U/G.	Sealing of affected area by stoppings dams, blanketing in quarry, sand flushing in fire area from surface boreholes.	Fire is restricted and in sealed off panels at present. Smoke and flame coming out on surface through subsidences are now checked due to filling of cracks.
2	Kurasia . .	do.	1963. Quarry debris/heap fire area. Spontaneous heating.	Trench cutting to isolate spoil heap area.	Trench completed.

3	North Chirimiri	Bijora Seam (II)	Spontaneous heating in depillaring area.	Sealing off of affected area and earth filling of subsidence cracks.	Area abandoned.
4	Pure Chirimiri	5th Seam (I)	do.	Isolated by stoppings	Fire under control.
5	South Jhagrakhad	'A' Seam (I)	Spontaneous heating in disused workings.	do.	do.
6	Biashinghpur	Johil top (II)	Spontaneous heating in depillaring area.	Isolated and flooded.	Fire under control.
7	Nowrozabad	Top and Bottom (III)	Spontaneous heating in goaf.	Isolation and blanketing.	do.
8	Mahakali	Mahakali (II)	Spontaneous heating in dev. (disused)	Isolation and flooding.	Fire extinguished and recovered.
9	Ballarpur	Ballarpur	1960—61. Spontaneous heating.	Isolation stoppings.	Fire finally controlled by stowing all around stoppings.
10	Datla East	No. 1 Seam (II)	Spontaneous heating of quarry edge.	Surface blanketing	Fire controlled.
	(C) Singareni Coalfields				
1	Singareni 2nd. incline.	..	Spontaneous heating 2nd incline area.	Fire area isolated	Fire controlled.

(1)	(2)	(3)	(4)	(5)	(6)
2	Singareni V. K. No. 7 incline.	..	Spontaneous heating in loose coal heap in blind end.	Fire area isolated.	do.
3	Singareni G. Khasi	..	Spontaneous heating in depillaring area.	Isolation and surface blanketing.	do.
	(d) Assam Coalfields				
1	Tipong	60 P.	1956. Spontaneous heating in goaf.	Entrances sealed off and filling up of cracks on surface.	Area later successfully recovered by opening out and isolating the affected panel only.
	(e) Ramgarh–Karanpura-Bokaro Coalfields				
1	Karkata	Karkata	Originated in 1959-60 in Karkata seam due to dumping of hot ash.	Construction of fire stoppings and cutting of an isolation trench. Later work of drilling of boreholes for sand flushing to form a sand barrier has been undertaken.	Fire, though active, is under control.

2	West Bokaro .	. VII	Heating detected in November 1964 in washery rejections due to spontaneous heating.	Quenching by fire and trench cutting.	Fire controlled.
3	Churi .	. Churi	1965-66 in goaf of Churi seam due to spontaneous heating.	Fire stoppings, packing of galleries and blanketing.	Fire under control, though protective works still going on.
4	Jharkhand .	. No. 22 seam	1965. *No.* 2 *fire* in quarry debris due to fire in 'bontulsi' surface vegetation. 1965. *No.* 3 *fire* in quarry debris due to spontaneous heating.	Isolation trenches and fire allowed to burn in the confined areas.	Fire No. 2 extinguished. Fire No. 3 though active is fully controlled.
5	Kedla .	. No. 22 seam	1966. Spontaneous heating in quarry debris.	Isolation trenching	Trench completed and fire isolated. It is now dormant.
6	Topa . .	. Topa	1966. Spontaneous heating in quarry debris.	do.	do.
7	Toera .	. Topa	1966. Spontaneous heating in quarry debris.	Isolation trenching	Trench completed and fire isolated. It is now dormant.

(1)	(2)	(3)	(4)	(5)	(6)
8	New Selected Dhori. .	Karo	1966. Spontaneous heating in quarry debris.	do.	do.
9	Laiyo . .	Laiyo	1967. Spontaneous heating in quarry debris.	Fire in abandoned areas. As no further damage expected, fire allowed to burn itself.	do.
10	Sounda. . .	Semana	1967. The old fire on the goaves of the seam passed through cracks to a triangular small pillar in Upper Semaua seam which was in a crushed state.	Initially affected area was tried to be isolated by stoppings but finally the incline entrances had to be sealed off.	The fire is active but affectively sealed.

ANNEXURE III

Extract from Coal Mines Regulations 1957 regarding Mine Workings & Precautions against Dangers from fire

MINE WORKINGS

99. *Development work:* (1) The dimensions of pillars and galleries, and the shape of pillars, formed in any seam or section shall be such as to ensure stability during the formation and extraction of pillars, and during the period between such formation and extraction.

(2) Save with the previous permission in writing of the Regional Inspector and subject to such conditions as he may specify therein no gallery in a seam or section shall exceed three metres in height or 4.8 metres in width at any place.

(3) The pillars formed in any seam or Section shall normally be rectangular in shape.

(4) The distance between the centres of any two adjacent pillars left in a seam or section shall not be less than that specified in the appended table as corresponding to the depth of seam or section from the surface at that point and the width of the galleries in the workings in question:

depth of seam from surface	where the width of the galleries does not exceed 3.0 metres	where the width of the galleries does not exceed 3.6 metres	where the width of the galleries does not exceed 4.2 metres	where the width of the galleries does not exceed 4.8 metres
the distance between centres of adjacent pillars shall not be less than				
(1)	(2)	(3)	(4)	(5)
	metres	metres	metres	metres
Not exceeding 60 metres .	12.0	15.0	18.0	19.5

(1)	(2)	(3)	(4)	(5)
	metres	metres	metres	metres
Exceeding 60 but not exceeding 90 metres .	13.5	16.5	19.5	21.0
Exceeding 90 but not exceeding 150 metres.	16.5	19.5	22.5	25.5
Exceeding 150 but not exceeding 240 metres.	22.5	25.5	30.5	34.5
Exceeding 240 but not exceeding 360 metres .	28.5	34.5	39.5	45.0
Exceeding 360 metres .	39.0	42.0	45.0	48.0

(5) Nothing in sub-regulations (2), (3) and (4) shall apply to workings in a mine made before the 7th September 1926. In such workings, the following provisions shall apply, except during the extraction or reduction of pillars—

(a) If the distance between the centres of adjacent pillars is smaller than that specified in the table appended to sub-regulation (4), the pillars shall not be further reduced; or

सत्यमेव जयते

(b) If the distance between the centres of adjacent pillars is not smaller than that specified in the table appended to sub-regulation (4), the pillars shall not be so reduced as to render such distance smaller than—

(i) the distance so specified; or

(ii) any distance required in this behalf by the Regional Inspector; and

(c) The height and width of the galleries shall not be further increased without the permission in writing of the Regional Inspector and subject to such conditions as he may specify therein.

(6) In the case of all workings, where in the opinion of the Regional Inspector the dimensions of pillars or galleries are such as to render it likely that crushing of pillars or the premature collapse of any part of the workings will occur either before or during the extraction of pillars, he may, by an order in writing, require such modification of the dimensions aforesaid in respect of any future working as he may specify.

100. Depillaring operations.—(1) No extraction or reduction of pillars shall be commenced, conducted or carried out except with the permission in writing of the Chief Inspector and in accordance with such conditions as he may specify therein. An application for permission under this sub-regulation shall be accompanied by two copies of an up-to-date plan of the area where pillars are proposed to be reduced or extracted, showing the proposed extent of extraction or reduction of pillars, the manner in which such extraction or reduction is to be carried out, the thickness and depth of the seam, the nature of the roof, and the rate and direction of dip.

(2) The extraction or reduction of pillars shall be conducted in such a way as to prevent, as far as possible, the extension of a collapse or sub-sidence of the goaf over pillars which have not been extracted.

(3) (a) Save as provided by clause (b) no pillars shall be reduced or split in such a manner as to reduce the dimensions of the resultant pillars below those required by regulation 99 or by any order made thereunder, nor shall any gallery be so heightened as to exceed three metres.

(b) During the extraction of pillars, no splitting or reduction of pillars or heightening of galleries shall be affected for a distance greater than the length of two pillars ahead of the pillar that is being extracted or reduced:

Provided that where pillar extraction is about to begin in a district, such splitting or reduction of pillars or the heightening of galleries shall be restricted to a maximum of four pillars. The width of the split-galleries shall not exceed the width prescribed for galleries under regulation 99(4).

(c) The Regional Inspector may, by an order in writing and stating the reasons therefor, relax or restrist the provisons of this sub-regulation in respect of any specified workings to such extent and on such conditions as he may specify therein.

(4) Except where the voids formed as a result of extraction are stowed solid with sand or other incombustible materials, no extraction of pillars in any seam or section shall be commenced until fire-dams or stoppings have been provided in all openings, other than openings essential for ventilation and haulage, around the area to be extracted; and in the roads kept open for ventilation, haulage, foundations for such dams or stoppings shall be prepared, and bricks and other suitable materials shall be kept readily available in their vicinity. Shale or other carbonaceous materials shall not be used in the construction of fire-dams or stoppings:

Provided that the Regional Inspector may, by an order in writing and subject to such conditions as he may specify therein, exempt from the operation of this sub-regulation any part of a mine where special conditions exist, which in his opinion make compliance with the provisions thereof not necessary or reasonably practicable.

(5) Where the method of extraction is to remove all the coal or as much of the coal as practicable and to allow the roof to cave in, the operations shall be conducted in such a way as to leave as small an area of uncollapsed roof as possible. Where possible, suitable means shall be adopted to bring down the goaf at regular intervals.

(6) Where the voids formed as a result of extraction are stowed with sand or other materials, the owner, agent or manager shall, on or before the 10th day of every month submit to the Regional Inspector a statement giving the quantity of coal raised and the quantity of sand or other material stowed in every district during the preceding month.

PRECAUTIONS AGAINST DANGERS FROM FIRE, DUST GAS AND WATER

116. General Precautions against fire.—(1) No oil, grease, canvas or other inflammable material shall be stored in any mine except in a fire-proof receptacle. In case of workings below ground, greasy or oily waste shall be regularly removed to the surface.

(2) No person shall place or throw, or cause or permit to be placed or thrown, any naked light or lamp on or near any timber, wooden structure, or other combustible material.

117. Surface precautions against fire.—(1) All surface structures and supports within a horizontal distance of 10 metres from all entrances to a mine shall be of fire-proof material:

Provided that this sub-regulation shall not apply to temporary structures, supports and coverings at the top of a shaft which is in the course of being sunk and to the small lid of a shaft-covering operated by the rope cappel.

(2) Shale or other carbonaceous material shall not be heaped or dumped and dead leaves or dry vegetation shall not be allowed to accumulate or remain, and combustible materials other than materials required for use within a period of 24 hours and inflammable materials shall not be stored, within a distance of 15 metres from any entrance to a mine, which is not effectively sealed off from the workings below ground:

Provided that nothing in this sub-regulation shall prevent the dumping of coal, raised from the mine, near the entrance to the mine.

(3) In opencast workings and, where possible, in any ground broken by extraction of coal, all wild or herbaceous plants shall be removed and all dead leaves and dry vegetation cleared as often as may be necessary to prevent an outbreak of fire.

(4) No person shall deposit any heated material or ashes on any outcrop of coal in any opencast working or on any ground broken by extraction of coal.

(5) No person shall light a fire or permit a fire to be lighted in any opencast working or within a distance of 15 metres from any entrance to a mine, except by the permis-

sion in writing of the manager and only for a special purpose specified therein. All such permissions shall be recorded in a bound-paged book kept for the purpose:

Provided that this sub-regulation shall not apply to boilers other than vertical boilers.

(6) A competent person shall, once at least in every seven days, inspect the top of all entrances to a mine, all opencast workings and any ground broken by extraction of coal in order to ascertain whether the precautions laid down in this regulation have been compiled with, and for the presence of any fire that may have broken out or any indications thereof. A record of every such inspection shall be maintained in a bound-paged book kept for the purpose, and shall be signed and dated by the person making the inspection.

118. Underground precautions against fire.—(1) (a) No timber or other combustible material shall be used in the construction of, or in connection with, any shaft lining or any room housing any machinery or apparatus below.

(b) Wood cuttings shall not be left in any working below ground, but shall be regularly removed to the surface.

(2) No person shall light a fire or permit a fire to be lighted in any workings below ground:

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Provided that—

(i) In the case of a mine to which regulation 144 does not apply, flame or electric welding or repairing apparatus may be used belowground if permitted by an order in writing of the manager. Every such order shall specify the person who shall be in charge of the apparatus, and it shall be the duty of such person to bring the apparatus back to the surface when no longer required belowground; and

(ii) In the case of a mine where the provisions of regulation 144 apply, a flame or electric welding or repairing apparatus may be used belowground if prior permission in writing has been obtained from the Regional Inspector and subject to such conditions as he may specify therein.

(3) (a) No person shall leave a portable light or lamp belowground unless he has placed it in charge of some other person remaining therein.

(b) At the end of a shift unless the mine is worked by a succession of shifts, after all persons have left the mine, all lights shall be extinguished and all power cut off.

(4) (a) No coal shale or other carbonaceous material shall be left or stacked belowground if it is likely to cause spontaneous combustion.

(b) Proper provisions shall be made to prevent an outbreak of the fire or spontaneous heating belowground or the spread of fire to the mine from any adjoining mine; and adequate steps shall be taken to control or isolate any such fire or heating that may occur.

(c) Where in the opinion of the Regional Inspector, the provisions of clauses (a) and (b) have not been complied with or where the compliance is inadequate, he may, by an order in writing, require such additional precautions or steps to be taken within such time as he may specify therein. If any such order is not complied with within the specified period, the Regional Inspector may prohibit, until the order has been complied with the employment in the mine or part, of any person whose employment is not, in his opinion, necessary for the purpose of complying with the order.

119. Precautions after a fire has broken out.—(1) (a) On the appearance in any part of a mine, of smoke or other signs indicating that a fire or spontaneous heating has or may have broken out, all persons other than those whose presence in the mine is deemed necessary for dealing with the fire or heating shall be immediately withdrawn from the mine. No person, other than those required for dealing with or sealing off the fire or heating, shall be re-admitted in the mine until the fire or heating has been extinguished or effectively sealed off and an examination has been made by the manager or by the under manager or assistant manager, and the mine has been declared to be safe. A report of every such examination shall be recorded in a bound-paged book kept for the purpose and shall be signed and dated by the person making the examination:

Provided that the Regional Inspector may by an order in writing and subject to such conditions as he may specify therein permit the employment in the the mine, of persons other than those required to deal with the fire or heating.

(b) The examination required by clause (a) shall be made with an approved flame safety lamp and a cage containing suitable birds or other means of detecting carbon monoxide gas approved by the Chief Inspector. No additional light shall be used other than an approved safety lamp or torch.

(2) During the whole time that any work of dealing with or sealing off a fire or heating belowground is in progress—

(a) a competent person shall be present on the spot throughout;

(b) approved safety lamps or torches shall be exclusively used in such work:

Provided that where safety lamps or torches are not immediately available, and it is necessary to take immediately steps to deal with an outbreak of fire, the provisions of this clause shall be deemed to have been complied with if persons engaged in dealing with the fire or heating are provided with approved safety lamps or torches as quickly as is reasonably practicable;

(c) there shall be available, at or near the place, two smoke helmets or other suitable apparatus for use in emergency, and

(d) there shall be kept at all places where persons are employed;

(i) a cage containing suitable birds or other means of detecting carbon monoxide gas approved by the Chief Inspector; and

(ii) a flame safety lamp or other means of detecting carbon dioxide gas approved by the Chief Inspector.

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120. Equipment for fire-fighting.—(1) A sufficient supply of sand or incombustible dust or sufficient portable fire-extinguishers shall be provided at every entrance to a mine at every landing and shaft bottom in use, at every engine room and at every other place where timber, canvas, grease, oil or other inflammable material is stored.

(2) At every mine, the following provisions shall be made for dealing with any fire or heating belowground—

(a) A sufficient supply of sand or incombustible dust or sufficient portable fire extinguishers shall be kept at suitable places at the entrance to every district; and

(b) In every mine employing 100 persons or more belowground on any day in that or the previous year—

(i) where pipes containing water under pressure are available, an adequate number of taps, not more than 120 metres apart, shall be provided on such pipes. Hosepipes not less than 60 metres in length, with necessary fittings shall be kept readily available at suitable places belowground; or

(ii) Portable water tanks fitted with hand pressure pumps and hosepipes not less than 60 metres in length and the necessary fittings shall be provided.

(3) (a) Soda acid type extinguishers or water shall not be used for fighting oil or electrical fires.

(b) Foam type extinguishers shall not be used for fighting electrical fires.

(c) Fire extinguishers containing chemicals which are liable, when operated, to give off poisonous or noxious gases, shall not be provided or used belowground:

Provided that nothing in this clause shall be deemed to prohibit the use belowground of fire extinguishers giving off carbon dioxide when operated.

(4) A competent person shall, once at least in every three months, examine every fire-extinguisher so provided, and shall discharge and refill it as often as may be necessary to ensure that it is in proper working order. A report of every such examination or refilling shall be kept in a bound-paged book kept for the purpose, and shall be signed and dated by the person making the examination or refilling.

121. Apparatus for testing for Carbon Monoxide.—In every mine to which regulations 122(2) and 144 apply, there shall be kept at the mine constantly available for use two or more suitable birds or other means of detecting carbon monoxide gas approved by the Chief Inspector:

Provided that the Regional Inspector may, by an order in writing require compliance with this regulation in the case of any other mine also.

122. Precautions when a fire exists.—(1) In every mine in which there is an active fire on the surface in any ash heap or spoil heap or otherwise in which a fire or spontaneous heating exists in workings belowground (whether such fire has been sealed off by means of suitable stoppings or not), no work whatsoever shall be done in any seam or section lying under the surface fire or either above or below another seam or section on fire or believed to be on fire, except with the permission in writing of the Chief Inspector and subject to such conditions as he may specify therein.

(2) Approved safety lamps or torches shall be exclusively used in a mine in which there is a fire belowground whether such fire is sealed off by stoppings or not:

Provided that the Chief Inspector may, by an order in writing and subject to such conditions as he may specify therein, exempt any mine or part thereof from the operation of this sub-regulation if in his opinion compliance with these provisions is not necessary.

(3) In every mine to which sub-regulation (2) and regulation 144, apply, arrangements shall be made, once at least in every 30 days, to ascertain the atmospheric conditions be-

hind the stoppings built to seal off an area of old workings or goaf or a fire or spontaneous heating, unless such stoppings are capable of resisting the force of an explosion.

(4) (a) Every stopping erected to isolate or control a fire or spontaneous heating belowground shall be numbered, and shall be of adequate strength and so maintained as to prevent any leakage of air or gas through it. Where water is likely to accumulate behind any such stoppings there shall be provided in the stoppings a suitable pipe or other device to drain away the water without permitting any leakage of air or gas etc.

(b) Where in any mine or part thereof the provisions of clause (a) have not been complied with, or where in the opinion of the Regional Inspector the steps so taken are inadequate, he may give notice in writing to the owner, agent or manager; requiring him to take such protective measures, within such time as he may specify therein. In case of non-compliance with the requirements of the notice, the Regional Inspector may, by an order in writing, prohibit until the requirements of the notice have been complied with the employment in the mine or part, of any person whose employment is not necessary for the purpose of complying with the requirements aforesaid.

(5) A competent person shall, once at least in every seven days, inspect all stoppings erected to isolate or control a fire or spontaneous heating belowground. During every such inspection he shall ascertain the general condition of every stopping check it for leakage and presence of gas, and ascertain the temperature and humidity of the atmosphere outside the stopping. For every stopping, he shall place his signature, with date, on a check-board provided for the purpose at a suitable position on the stopping and this record shall be maintained for a period of not less than three months. A report of every such inspection shall also be recorded in a bound paged book kept for the purpose and shall be signed and dated by the person making the inspection:

Provided that the Regional Inspector may, by an order in writing require such inspection to be made at such shorter intervals as he may specify therein.

ANNEXURE-IV

Provisions relating to Mine Fires and Methods of workings under Coal Mines (Conservation & Safety) Act and Rules.

A. Coal Mines (Conservation & Safety) Act, 1952

1. *Function of Coal Board: Section* 5(1) : The Board may, for the purpose of maintenance of safety in coal mines or for conservation of coal, exercise such powers and discharge such duties as may be assigned to it by or under this Act.

2. *Powers of the Board in executing operations:*

Sec. 6(1) : If in the opinion of the Board, it is necessary or desirable that any measures, including stowing, required in furtherance of the objects of this Act should be undertaken directly by the Board, the Board may execute or cause to be executed such measures under its own supervision.

Sec. 6(2) *:* For the purposes of this section, the Board shall have the right for itself and all persons employed in the execution of any work undertaken under this section to enterupon any property in which the work has to be done, and to do therein all things necessary for the execution of the work.

Sec. 7(1) *:* The Central Government, may, for the purpose of maintenance of safety in coal mines or for conservation of coal, exercise such powers and take or cause to be taken all such measures as it may deem necessary or proper or as may be prescribed.

Sec. 7(2) *:* Without prejudice to the generality of the foregoing power, the Central Government may, by order in writing addressed to the owner, agent or manager of a coal mine, require him to take such measure as it may think necessary for the purpose of maintenance of safety in coal mines or for conservation of coal, including—

(a) in any coal mine, stowing for safety.

Sec. 13(3): Without prejudice to the provisions of section 19 of the Indian Mines Act, 1923 (IV of 1923), the Chief Inspector or any Inspector may, by order in writing addressed to the owner, agent or manager of a coal mine, require him to take such protective measures, including stowing, in the mines as the Chief Inspector or the Inspector may think necessary, if in the opinion of the Chief Inspector or Inspector—

(a) the extraction or reduction of pillars in any part of the mine is likely to cause the crushing of pillars or the premature collapse of any part of the working or otherwise endanger human life or the mine, or a railway, or

(b) adequate provision against the outbreak of fire or flooding has not been made by providing for the sealing off and isolation of any part of the mine or for restricting the area that might be affected by fire or flooding, as the case may be.

Sec. 13(4)* The powers conferred on the Inspector under sub-sections (1), (2) and (3) may also be exercised by such officers of the Board suitably qualified in this behalf as the Central Government may, by notification in the official Gazette, specify in this behalf.

[(4) *— Power delegated to the Chief Mining Engineer and Deputy Chief Mining Engineer by Notification No. C5-5(3)/52, dated 14-2-62 and to the Inspecting Officers of the Board by notification No. 25-CI (6)/52, dated 28-5-62.]

B. Coal Mines (Conservation & Safety) Rules, 1954.

1. *Regarding opening, method of working, depillaring etc.*

Rule 38(2): The Central Government may by order in writing, served on the owner, agent or manager of a coal mine require the method of working in any coal mine or seams to be modified in such manner as it deems necessary for the purpose of ensuring the conservation of coal.

Rule 38(3)*:* The Central Government may by order in writing served on the owner, agent or manager of colliery prohibit the carrying out of depillaring operations in the colliery or a seam without stowing or the splitting of pillars as a final mining operation in a colliery or a seam or any other operations connected with mining, which in the opinion of the Central Government may result in undue loss of coal, spread of fire or flooding.

Rule 38(4)*:* The owner, agent or manager of a coal mine shall give notice in writing to the Board of his intention to depillar in any coal seam or of his intention to split pillars in any seam as a final operation in mining and such notice shall be given at least three full months before the date of commencement of such mining operations provided that no notice need be given where the depillaring is carried out with the aid of stowing.

Rule 39(1)*:* No coal mine or seam or section of a seam shall be opened and no coal mine or seam or section of a seam the working where of has been discontinued for a period exceeding six months shall be re-opened and no operation shall be commenced without the prior permission in writing of the Board and except in accordance with such directions as the Board may give.

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Rule 40(1)(*a*)*:* Save where a coal mine is closed or abandoned owing to unforeseen or uncontrollable natural causes such as fire or flood, the owner, agent or manager of the coal mine shall give notice in writing of his intention to close the mine or any seam or section of a seam thereof to the Board not less than ninety days before the date on which it is proposed to close the mine, the seam or the section of a seam, stating briefly the reasons for the intended closure;

Rule 40(1)(*b*)*:* Where the closure or abandonment is due to unforeseen or uncontrollable natural causes such as fire or flood, he shall within 15 days after such closure or abandonment, report the same to the Board.

2. *Execution of protective measures directly by the Board:*

Rule 44: The Central Government or with the approval of the Central Government the Board may recover from the owner, agent or manager of a colliery either wholly or partially the cost of such measures or operations as are undertaken under section 6 if it is satisfied on consideration of all facts and circumstances that such recovery of cost is justified.

Rule 48(2): The Board may, for reasons to be recorded in writing sanction the payment from the Fund of the full cost of any protective measures undertaken under section 6 provided that:

(i) subject to the provisions of clause (ii) of this provision the Board shall not undertake any such protective measures without the previous sanction of the Central Government, if the estimated cost of such measures exceeds rupees one lakh.

(ii) In the case of protective works of an emergent nature which brook no delay and are estimated to cost more than Rs. 1 lakh but not more than Rs. 5 lakhs the Board may commence the work and simultaneously apply for sanction. The actual expenditure should not in any case exceed Rs. 1 lakh until Government sanction is obtained.

Para 58 *of Coal Board Manual,* 1967: In case the Board, under section 6 of the Act, decides to undertake stowing or other protective measures directly, because of the failure of the owner, etc., to carry out the orders under section 7 of sub-section (3) or sub-section (4) of section 13, or for any other reason, it may in accordance with Rule 44, recover the cost thereof from the owner or owners of coal mine concerned. Provided that Board may, in accordance with Rule 48, for reasons to be recorded in writing, recover only a part of the cost.

3. *Purposes for which assistance may be granted and forms of assistance etc.*

Rule 49(1): The Board may grant assistance from the Fund to any owner, agent or manager of coal mine.

Rule 49(1)(*a*)*:* for stowing or other protective measures which are required to be undertaken by an order issued under sub-section (3) of section 13 or sub-rule (2) of Rule 35; or sub-rule 3 of rule 40;

Rule 49(1)(*b*)*:* for any measures which in the opinion of the Board are essential for the effective prevention of the spread of fire to or immudation by water of any coal mine from an area adjacent to it;

Rule 49(1) (*d*) (*iii*)*:* any other measures for safety in coal mines or for conservation of coal.

Rule 51(1)*:* Priority among applications under rule 49 shall be determined by the Board according to the degree of urgency of the proposed operations from the point of view of safety and of conservation.

Rule 52*:* The Board may grant assistance from the Fund, at its discretion in each case in one or more of the following ways:—

- (i) by the grant of stowing materials;
- (ii) by the loan of stowing plant or such other plant as the Board may decide;
- (iii) by making monetary grants;
- (iv) by the grant of loan for meeting either wholly or in part expenses of the purchase and installation of stowing plant in coal mines, blending plant or washing plant or any other plant for the beneficiation of coal.

oal Board Manual 1967*:*

Para 41*:* Protective works generally consists of the following:

- (a) Blanketing with incombustible material.
- (b) Filling up of subsidence.
- (c) Cutting of trenches.

(d) Construction of dams.

(e) Artificial barriers.

Para 42: Assistance in the form of a monetary grants towards expenses will normally be granted by the Board for any protective measure which, in the opinion of the Board, is essential for prevention or spread of fire in any coal mine or prevention of inundation by water, whether arising from the same mine or adjacent mines and lands. The quantum of such assistance shall not exceed 85% of the actual expenditure incurred by the owner of the mine or 85% of the cost of the measure as may be estimated by the Inspecting officer, whichever be less. In case, however, the Board is of opinion, after conducting such enquiry as it may deem necessary and feasible, that the protective works have been necessitated due principally to the negligence of the owner, agent or manager of the mine involving contravention of the Coal Mines Regulation, 1957 or violation by owner of the mine of any direction issued by a duly authorised officer of the Inspectorate of Mines or the Coal Board, the Board may decide to refuse to grant assistance completely or grant assistance completely or grant it only partially.

Para 43(*i*): Assistance shall be granted with the regard to all circumstances of each case and shall be subject to actual expenditure incurred and any ceilings that may be fixed by the Board.

Para 43(*ii*): Assistance shall not be granted for maintenance of protective works.

Para 44(*i*): A protective work or measure shall not qualify for assistance if it is a normal requirement under the Mines Act, 1952 or the Coal Mines Regulations, 1957, *i.e.* construction of isolation stoppings, provided that assistance may be given for the packing and the outer wall in explosion proof stoppings.

The first inner stopping round a goaf for isolating a fire or putting an explosion proof stopping was the statutory responsibility of the owners of the collieries. The Board will, however, assist any packing done against the inner stopping or a retaining wall put into hold the packing material

Para 44(*ii*) *:* Where protective work comprises making artificial barrier by packing, it will be necessary to complete the retaining wall and packing before starting the depillaring operation, in order to qualify for assistance.

tance from the Fund for the prosecution by any agency of such types of research work connected with safety of coal mines or conservation and utilisation of coal as may be a authorised by the Central Government.

Rule 56(2) *:* The Board may also arrange for the prosecution of research work under its own supervision.

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